

AIRFOIL SECTION– 2" SQUARES

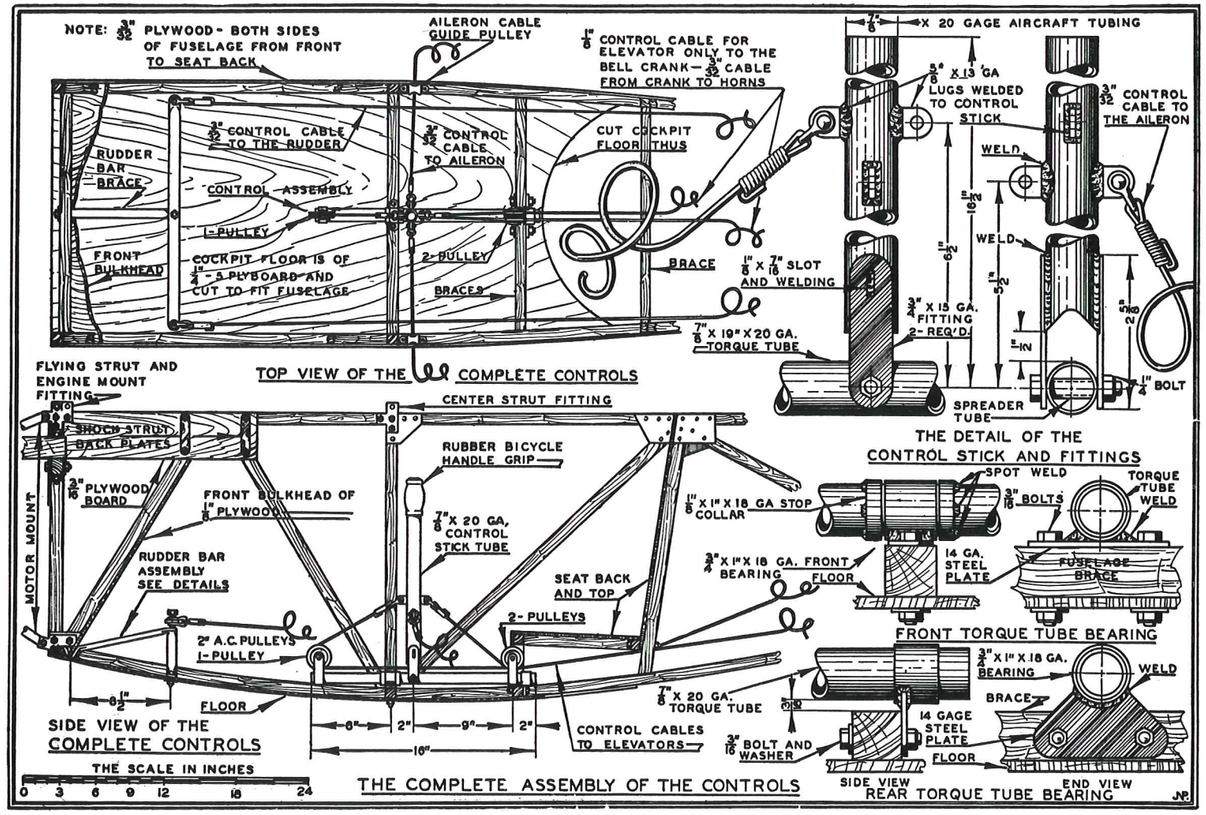
INSTRUMENT PANEL AND BASIC FLIGHT INSTR'MTS.

SPRING-LOADED SHOCK STRUT OR 1-1/2" X 18 GA. STRUT IF AIRWHEELS ARE EMPLOYED

L/G DETAIL – AXLE, WHEEL AND STRUT FIX

SECTIONS THRU SPARS

TYPICAL TAIL CONSTRUCTION & HINGE DETAILS



This drawing shows the complete assembly of the controls, which are installed in the conventional manner. Aileron, elevator, and rudder horns and other details will be found on the smaller working drawings. If you are not an expert at welding, this work should be sent out, as failure of the controls has an annoying inclination to become embarrassing.

Tack a piece 60 in. wide the full length of the wing all around the edge, bottom side first. Give the edge a coat of dope, turn the wing over and do the same on top.

Now sew the cloth to the ribs in the regular manner, put on a coat of dope, then all the tape and patches around fittings and give the wing four extra coats of dope (five in all).

The last two coats may be colored. I advise a light coat of paint on the wing if you wish the cloth to last a long time, although this makes the ship harder to patch.

Just a little warning, be sure and put the flap in the center. A lot of those building the Air Camper did not do this but put a large opening instead and spoiled the climb of the ship. Remember that you cannot have all the features of a high powered plane in a small Ford powered ship and expect it to fly well. And the flap is one of the things that makes these ships a success.

The first thing to remember in building a low powered ship is to keep the weight down and to keep the efficiency up.

After you have your ship complete, that is, the motor in, tail group on, all controls in, and are ready for the wing, make up your center struts like drawings (see next installment), all brace wires made, get about four extra helpers, put the wing on the center struts and line up.

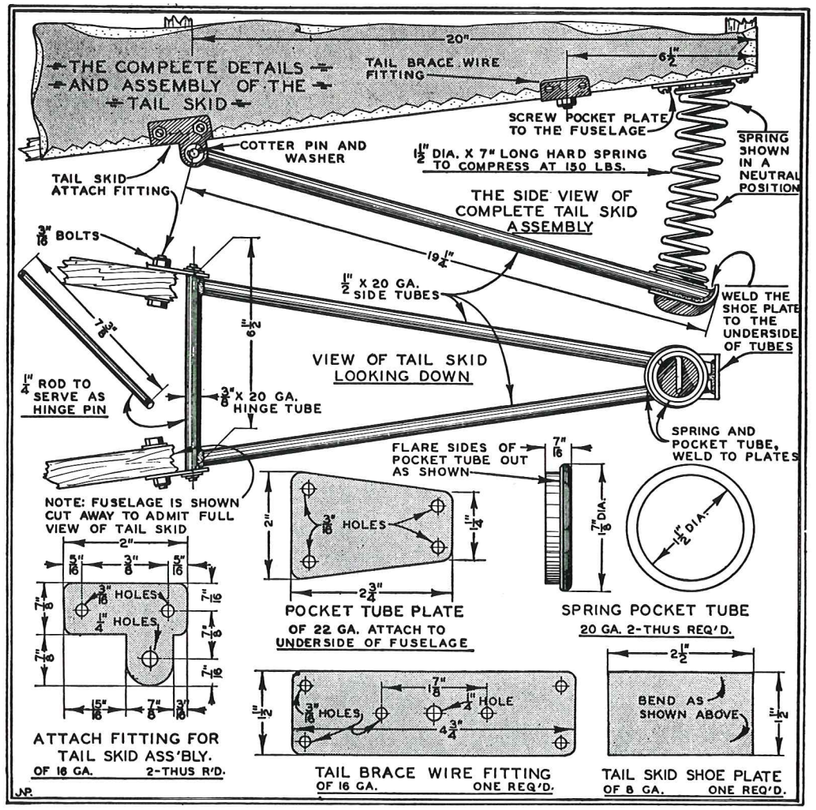
Next have someone hold up the ends of the wing so that it will have a little dihedral, and measure the length of the front flying struts. These should both be exactly the same length. When these are in place, do the same with the rear flying struts. Now make the flying or brace wires. Hook up the ailerons, safety all turnbuckles and your ship should be ready to go.

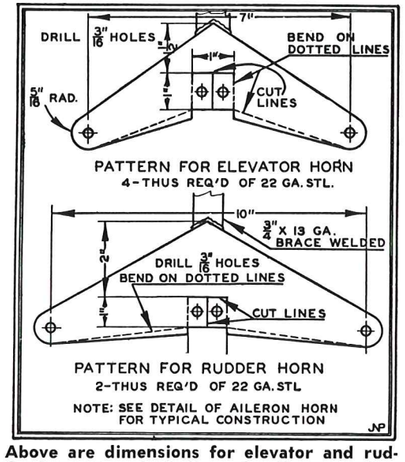
I will likely get a lot of letters saying that I did not cover the whole ship, but if I were to do this it would take more space than this whole magazine.

I personally think that if you cannot build a ship from the plans alone, that all the instructions it would be possible to write would not do you much good.

But as I said before, if you know your stuff,

Complete details for the tail skid are given here. Be sure to weld the keel onto the underside of the skid-shoe.

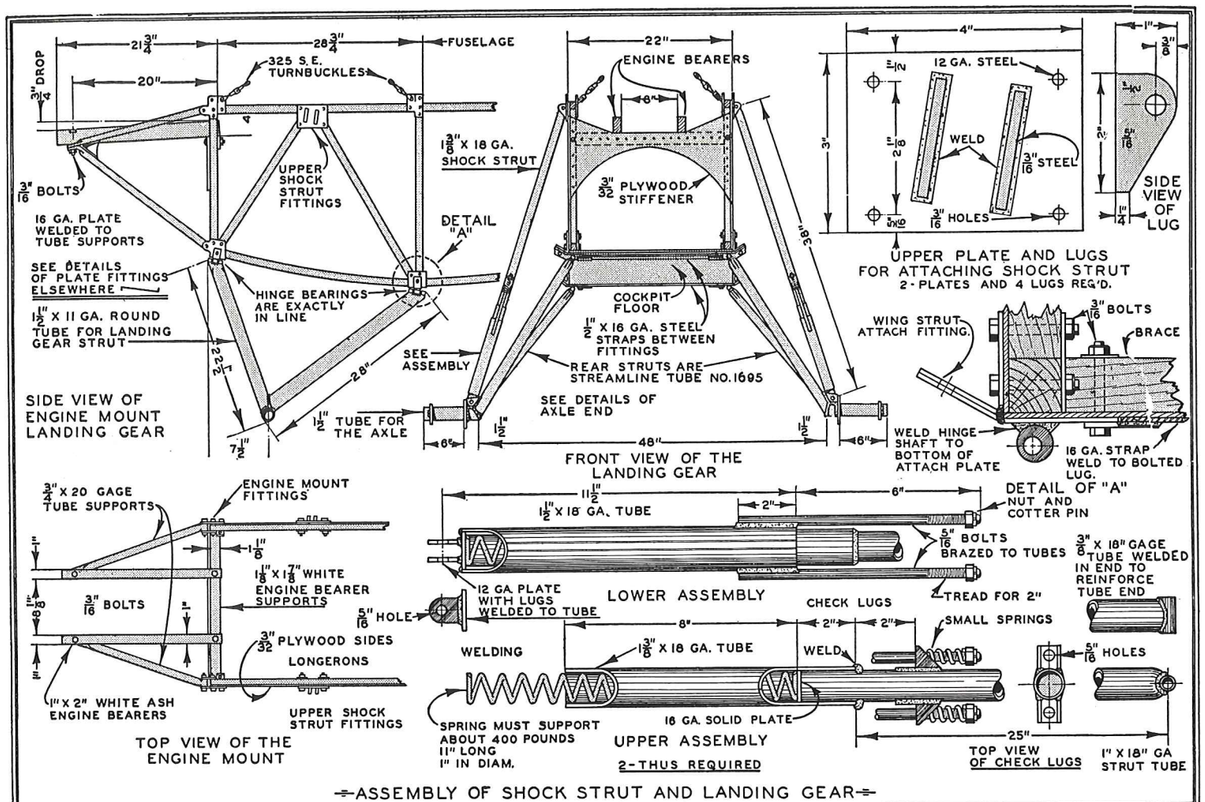




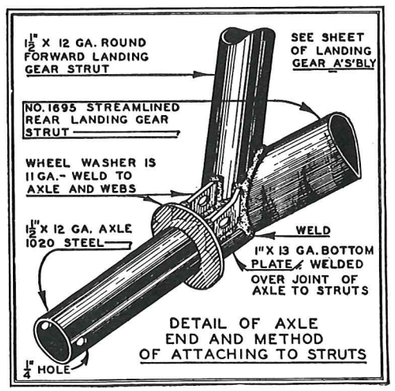
Above are dimensions for elevator and rudder horns. For typical construction see aileron horns in first installment.



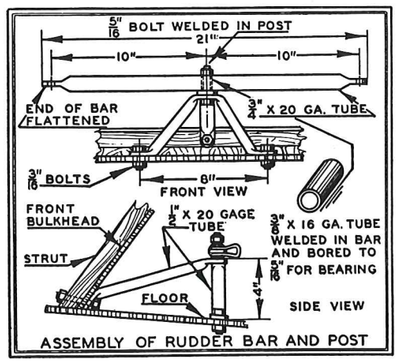
Rear Admiral Don Finke shows the tail skid and rear assembly. This plane is light enough for the average man to wheel in and out of the hangar without assistance.



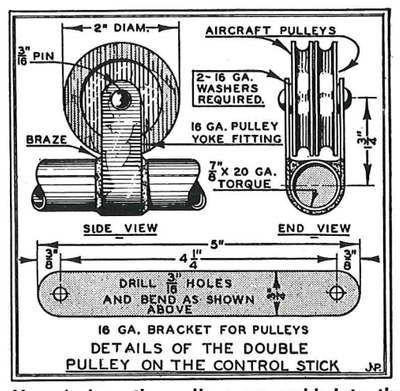
This working drawing shows the extremely rugged split-type landing gear designed especially for the Sky Scout. At the left will be found the dimensions for the bolted steel and ash motor mount. Further details found elsewhere.



Here is how the axle end is welded to the landing gear struts. A workmanlike job of welding is vital at this point.



This drawing gives details and dimensions for building and assembling the rudder bar and post. The ends of the rudder bar are flattened and a hole drilled for the cable.



Here is how the pulleys are welded to the control stick torque tube. One pulley is used in front and two at the rear.

you may be able to make improvements in this ship and I would like to hear from those doing it, as it is one of my greatest desires to see the lightplane developed into one of the safest and best sports there is.

I believe this to be the safest lightplane there is, and if this design is a start in that direction it has all been well worth the time we have put into it. But those of you who wish only to build so that they will have something to fly had better build it exactly as the plans, and you will be sure of having a ship that is very easy to handle. It is cheap to run and will land and take off at a field where the average OX5 job, or similar powered ship, would be completely out of luck.

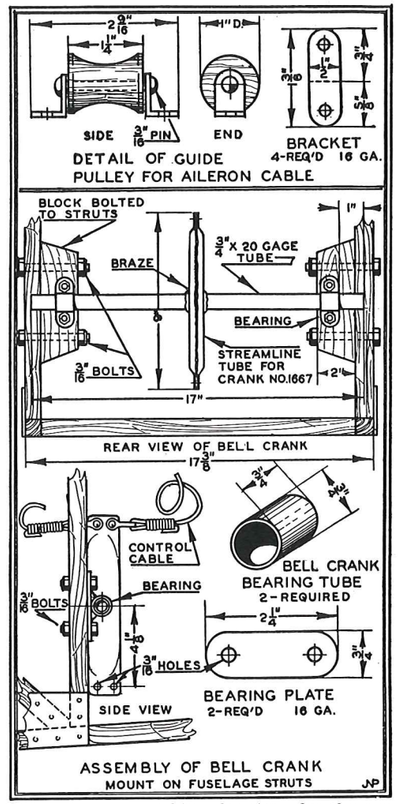
I am sure if you ever come to our field and see these ships fly you will agree that these planes will do all we claim they will — and then some.

If you fellows are going to build this ship for the Model T motor, well and good, but if it goes for the Packmag Twin, then here's a word or two on that motor and what it will do to your ship.

It was originally designed by Earl D. Hilburn for use with all of the type of ships which can be flown with around 30-40 hp. She was built at the MECHANICAL PACKAGE MAGAZINE'S Experiment Station, and, after considerable machining, took final form and was tested in a ship like the Air Camper.

This motor sells in the rough casting form for $75.00, and in the finished machined form for $261.00. It will make this plane have pursuit ship performance and it will be able to carry considerable pay load, although the fuselage is not stressed for two-place work. I imagine a top speed of 95 miles and an even lower landing speed due to lower weight would give this ship some real soup.

It is not necessary to have very elaborate machine shop equipment to build the engine. If you have a small lathe, the cylinders can be bought machined, and then the crankcase and the shaft and all can be bought as is necessary.



Here are more working drawings for the control fittings. Dimensions for the construction of the bell crank and guide pulleys for the aileron cables are shown above.

A longer mount will have to be put on the ship and it should extend 13 in. farther out than the Ford T due to its lower weight of 120 lbs.

The Cross Country can be cowled in to make the ship have Army type looks and this is always something to be desired — a classy ship.

I don't know about the proposition of floats with a Model T. I do know you can't use them as the motor won't have enough soup. The usual procedure for any land plane which performs well as a land plane is to add 50 percent more power when used as a sea plane.

This is because of the increased resistance of the floats, which have their highest resistance just before they begin to plane. After that they become less and less drag until they take off and the ship's highest speed is reached, which of course means that the drag has reached the highest proportions possible with that power.

Next chapter we will take up the engine details and the method of mounting the good old Model T, which, after all, is the ideal for this ship as she was designed. •••

PART 3

Engine Details of the "Sky Scout"

Here we round the pylon on the home stretch in one of the most popular how-to-build stories we have ever published. This series on building the Sky Scout, slightly smaller sister to the Model A powered Air Camper, is second only in popularity to the series run on the building of that famous ship. Here are finishing details of motor conversion, operation, ship finishing and flying hints. Bank her over and rip in!

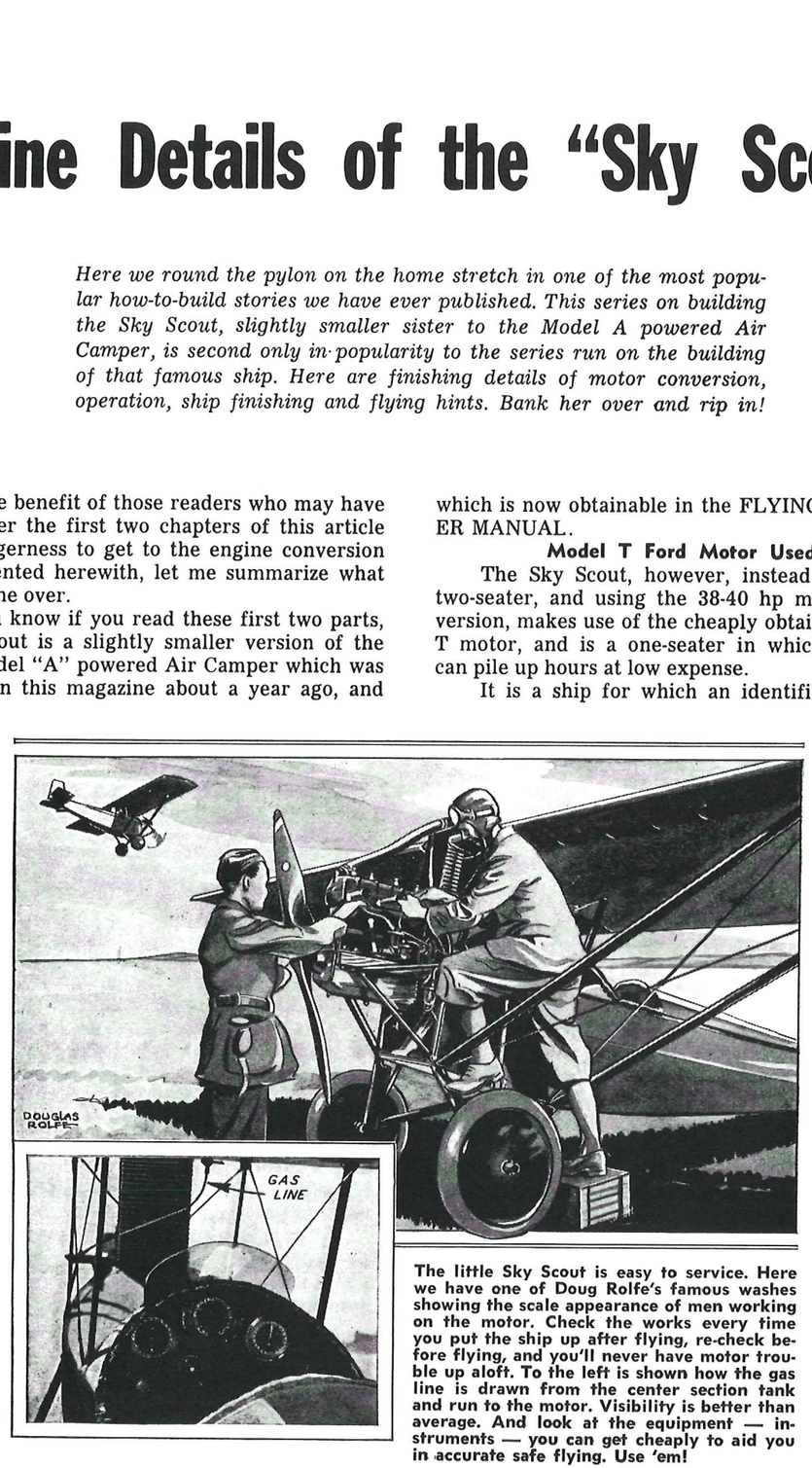
For the benefit of those readers who may have skipped over the first two chapters of this article in their eagerness to get to the engine conversion plans presented herewith, let me summarize what we have gone over.

As you know if you read these first two parts, the Sky Scout is a slightly smaller version of the famous model "A" powered Air Camper which was published in this magazine about a year ago, and which is now obtainable in the FLYING and GLIDER MANUAL.

Model T Ford Motor Used

The Sky Scout, however, instead of being a two-seater, and using the 38-40 hp model A conversion, makes use of the cheaply obtainable model T motor, and is a one-seater in which a student can pile up hours at low expense.

It is a ship for which an identification number



The little Sky Scout is easy to service. Here we have one of Doug Rolfe's famous washes showing the scale appearance of men working on the motor. Check the works every time you put the ship up after flying, re-check before flying, and you'll never have motor trouble up aloft. To the left is shown how the gas line is drawn from the center section tank and run to the motor. Visibility is better than average. And look at the equipment — instruments — you can get cheaply to aid you in accurate safe flying. Use 'em!

shock cord cutting. The landing gear should give not over one inch with a full load in the ship, but neither should it be any tighter.

The Tail Skid

The tail skid comes next. This is of extremely simple construction, but it has proved so efficient that we are now using it on all of the planes we build. Be sure to put a small keel on the shoe or you will find your ship hard to steer on a windy day. This keel will also help to prevent the beginner from ground looping.

The Empennage

And now for the empennage. If you saw the plans of the Air Camper you will see at a glance that the tail surfaces of the Sky Scout follow the same general lines as those of its big sister. I have, however, cut down the weight a little at this point and I also believe I have given the Scout a bit the best of it on the lines.

But outside of a bit of cleaning up I have seen no reason for changing this part of the ship, as the assembly on both jobs has given quick and sensitive control of the ship at all times. And another thing which is even more important — if you follow these plans you need have no fear of any structural weakness in this most vital part of the ship.

The Motor Mount

In the motor mount you will notice that there is a drop of about one inch on the front of the motor mounting. I have had a lot of so-called experts tell me that this should not be. However, I reason that the motor should pull in the direction of travel and not the way the ship points.

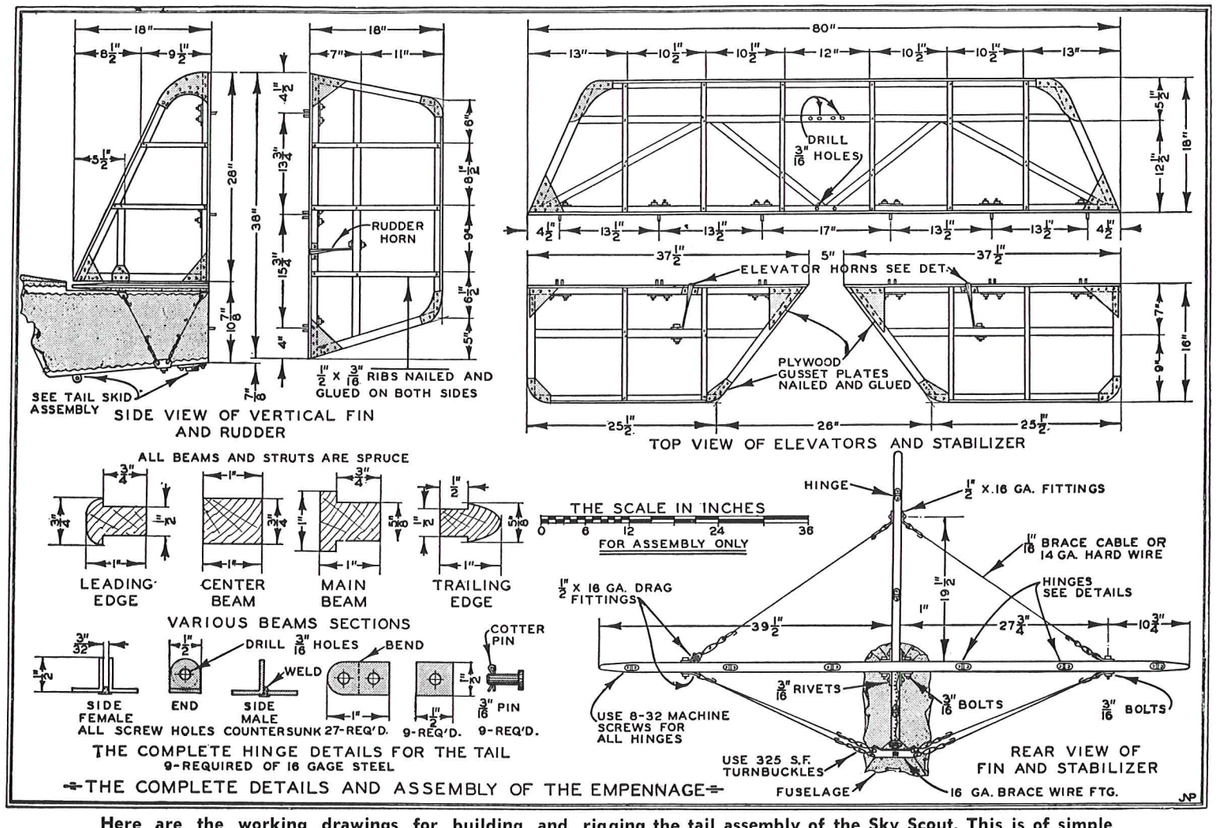
We built one ship using a straight motor bed and the climb was not so good, while it was almost impossible to fly it hands off, except at one speed and throttle setting; so my advice is to be sure and give this drop on the front of the motor.

The motor mounting itself is well shown on the drawings and I wish to say it is all built right on the fuselage.

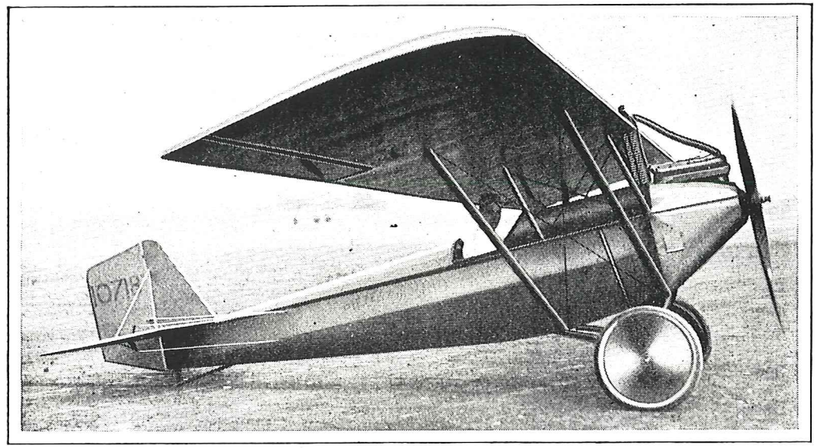
The motor bed pieces are bolted on and temporarily braced and then the motor support tubes are fitted to the fittings and bearers.

The Covering

Now put in the gas tank (5½ gal.) and the wing is ready to cover. You may use any light grade of aircraft cloth for this or you may use sheeting.



Here are the working drawings for building and rigging the tail assembly of the Sky Scout. This is of simple wood construction, and no plans have been drawn for a steel tube job. The scale applies only to the assembly drawing.



A real airplane, m'lads, and it gets its power from the innards of a Model T Ford. This ship is just as sturdy as it looks, is easy to build, and can take off and land at a field which would stump an OX-5 or like-powered job.

PART 2

TAIL GROUP AND FUSELAGE FITTINGS PLANS FOR THE "SKY SCOUT"

Continued in this chapter you will find Author Pietenpol's description of how to build the tail group, control fittings, and this unique tail skid.

You fellows who have been demanding a real airplane powered by a Model T Ford engine have no doubt digested the previous installment, in which we discussed what could be expected of the ship, and in which you were given part of the plans and instructions for building.

In the first installment, you will remember, we took up the building of the fuselage and wings. Now we will go on from there. The present installment will include the tail assembly, landing gear, and controls.

The Landing Gear

We will first take up the landing gear. This has proven to be a very strong outfit which will stand plenty of abuse. While it would be difficult to explain how this is built, the plans are very clear and you should have no trouble.

You will have to use a turning lathe and be a good welder to make the gear shown here. You may also build the type of landing gear that is used on the Air Camper. You will find that this is much easier to make and is quite strong enough.

While we are on the subject of this gear we had better put on some safety device to keep the ship from dropping to the ground if the shock cord breaks, since it seems that everybody has trouble wrapping shock cord.

Here is the method we use: First cut a piece of leather to fit around the bottom of the landing gear vee, and lace it on with lace leather. Now take 6 ft. of ½ in. shock cord and have someone hold it about half way up on the outside of the front landing gear strut. Take the other end and pass it under the landing gear vee, over the axle, under the landing gear, over the axle, under the vee on the inside of the first wrap, over the axle on the outside of the first wrap and under the vee on the inside of the last wrap until you have three wraps pulled quite tight.

The cord should be just long enough to make a good square knot and to permit taping of the ends. This method makes each wrap about the same length and you will not have any trouble with your

ber can be had from the Department of Commerce, and while I have heard that a few over-zealous inspectors will ground a ship if it doesn't have a "C" of some kind, you will find that all state legislation hinges upon the Federal air laws, and that anyone can fly for himself on an unlicensed field in an unlicensed ship if he wishes. All that the states ask is that the Federal laws be observed and that unlicensed ships not be flown from licensed airports.

So much for our introduction.

Part one took up the building of the fuselage and the wings.

Part two explained the landing gear, tail surfaces, and control system.

Now, in part three, we will have a little word to say about the minor fittings, the finishing of the ship, and the method of fixing up what little conversion work there is to making the Model T a good airplane engine.

We will take the power plant first, as the whole ship is of course built for the motor it will be using.

This ship was built for the model T of course, but may I say that the cowling is big enough for the model A. There is not much difference in the sizes of these two motors, but you will need a new engine bearer if you use an A, and also put the wing about an inch ahead.

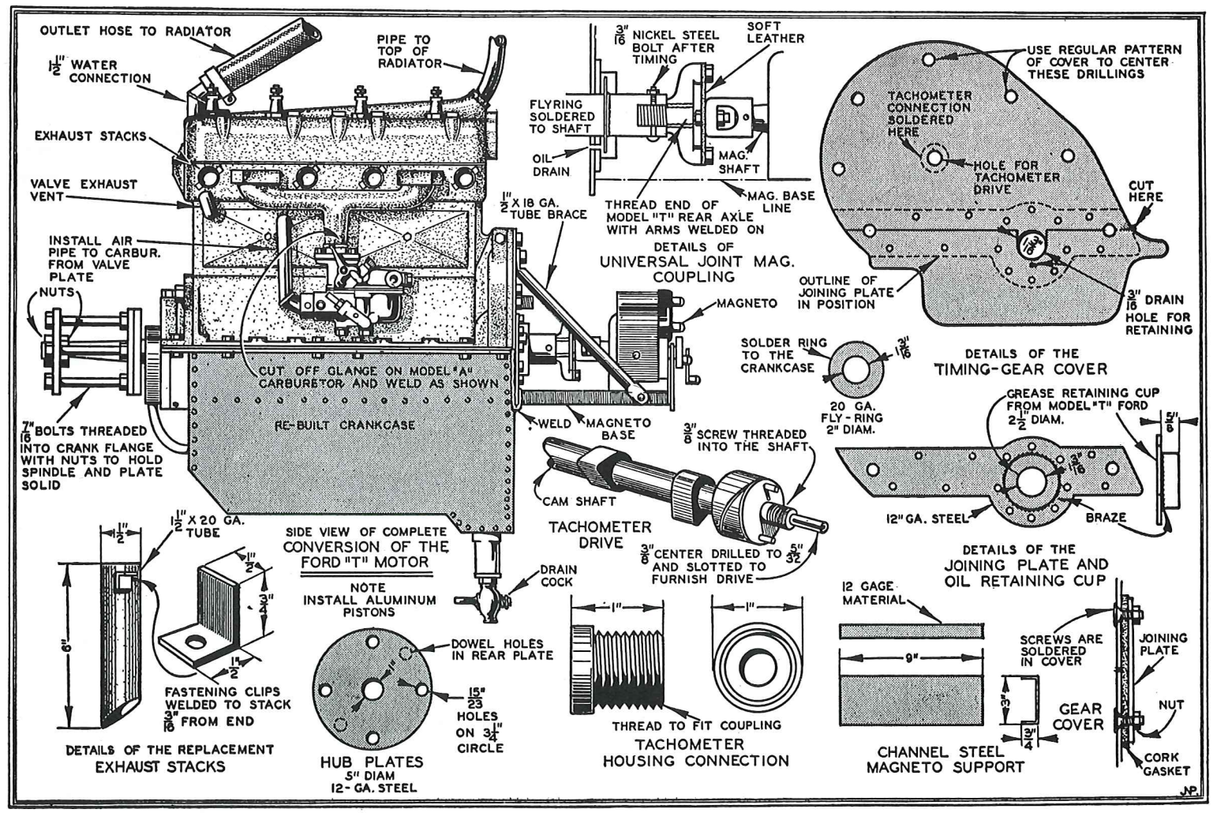
Model A Carburetor Favored

We did not make plans for the motor as everyone has his own ideas on the subject.

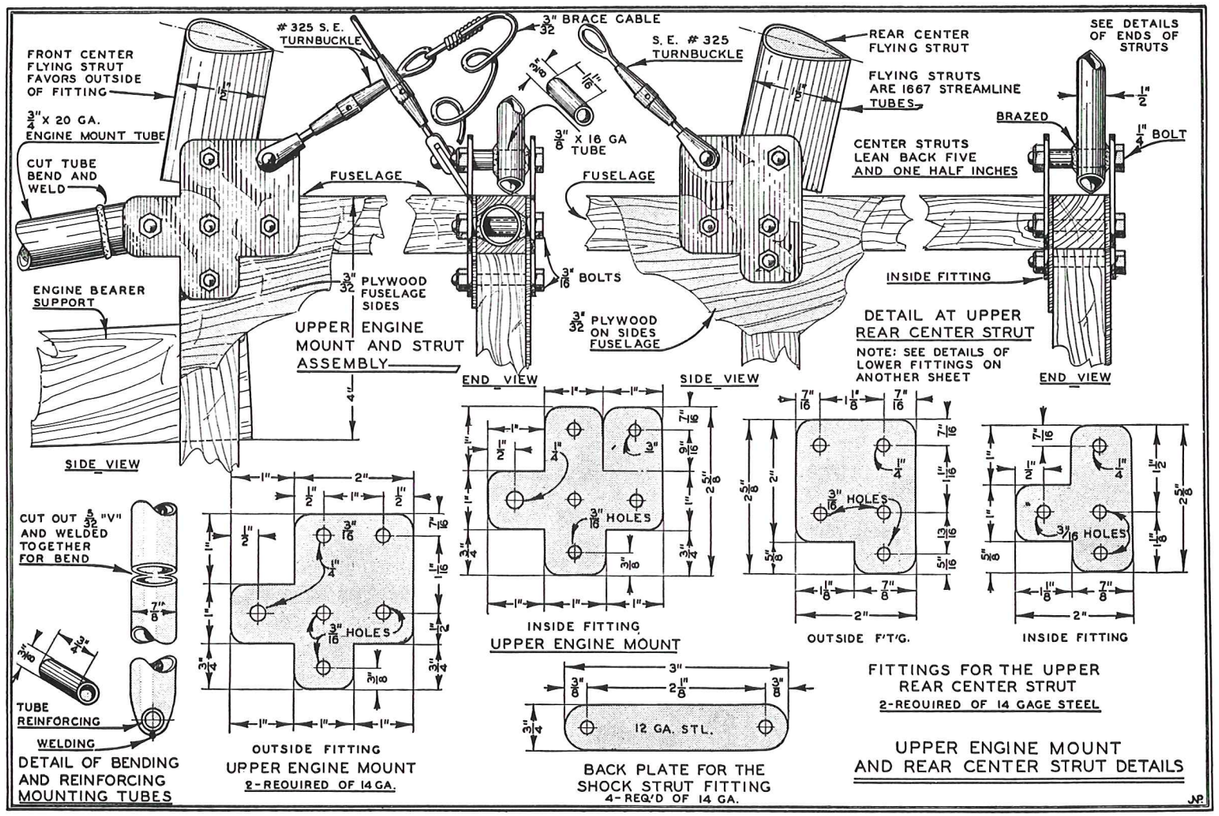
As long as they cool well and oil well they all work about the same in an airplane as in a car. The following changes were made. A model A carburetor was used. Cut off the intake flange where the carburetor was fastened and weld it back on so that a model A carburetor will fit. See drawing.

Exhaust stacks are put on. Aluminum pistons were installed. The regular head and valves were used (putting in larger valves won't help — the passages aren't big enough to let the gas flow any faster). The end of the camshaft was fixed for a tachometer drive as was shown on the drawings in the Manual and prints for the A conversion. Be sure and put in a tachometer. They are very necessary and don't cost much.

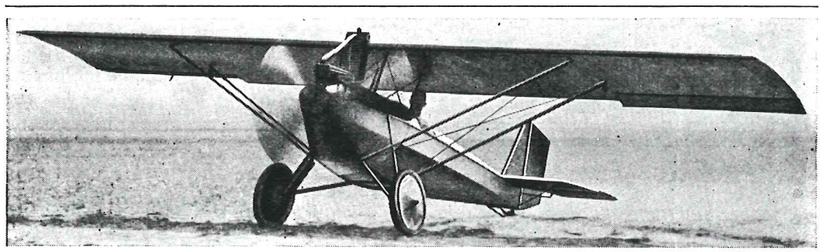
A fellow had an Air Camper here this summer without any instruments in it. I flew it but surely did not like it that way. I say, the more instruments the better. We use a complete set on all



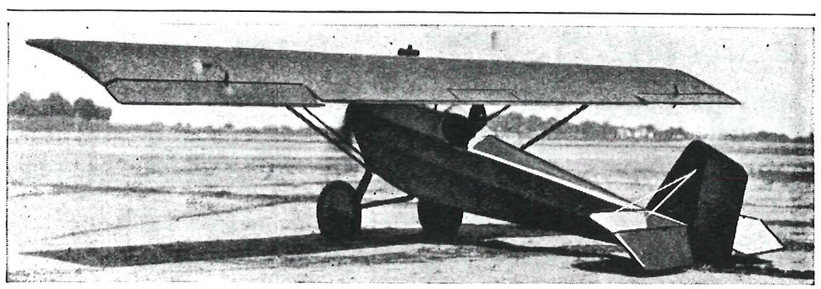
By studying this drawing you will see how easy it is to convert the "T" Ford for the Sky Scout. No water pump is needed.



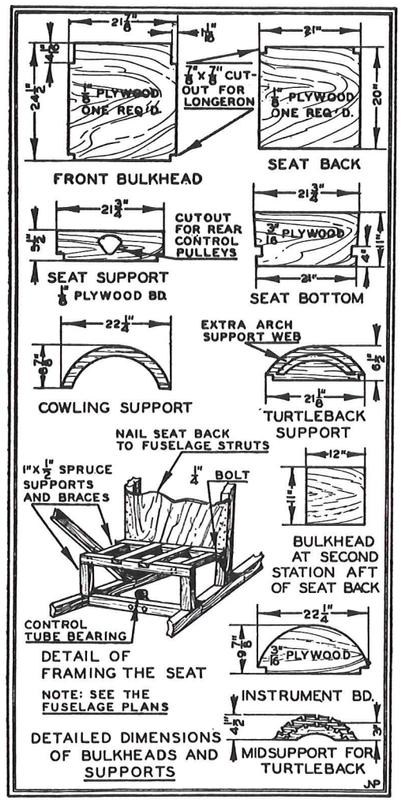
Here are shown complete dimensions of the upper engine mount plates and of the strut fittings and turnbuckles.



Always warm the ship up a little before taking off. See that the oil is warmed all through, and that the water and valves have warmed up. Some peelots have felt they were driving a car with these motors. Be sensible!—it pays to take pains!

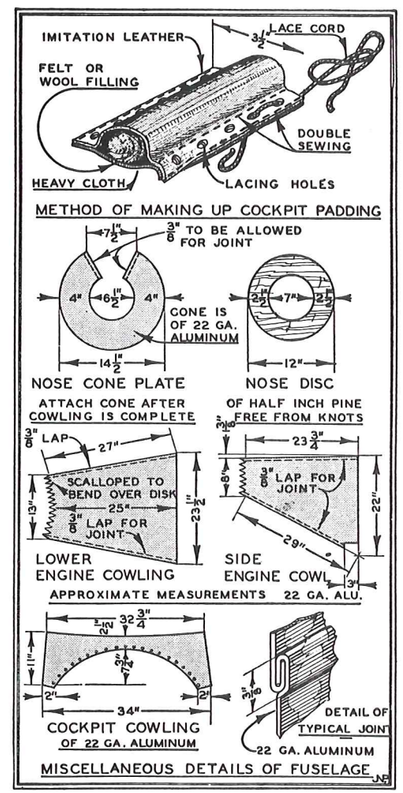


The Sky Scout is but a few inches larger than a Heath, but a few inches smaller than an Air Camper. It will fly nicely on the Model T Ford engine and is very rugged. The ship will also make a very high speed "hot" ship with a Pack Mag "Cross Country Twin" 40 hp twin opposed motor. Note flap in rear of wing to admit pilot to cockpit.



Right— Dimensioned drawings for miscellaneous fuselage fittings.

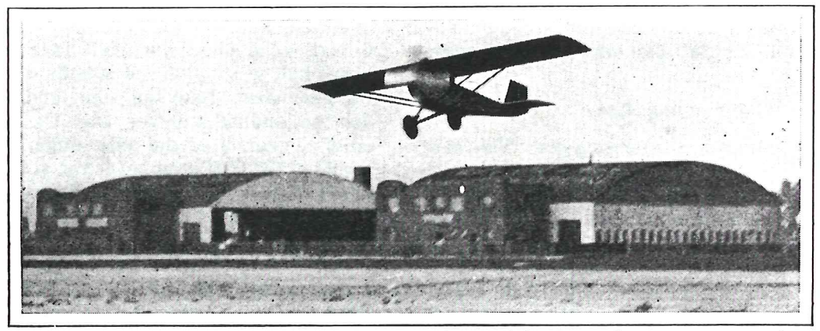
Left — Detailed drawings of the seat and bulkhead construction.



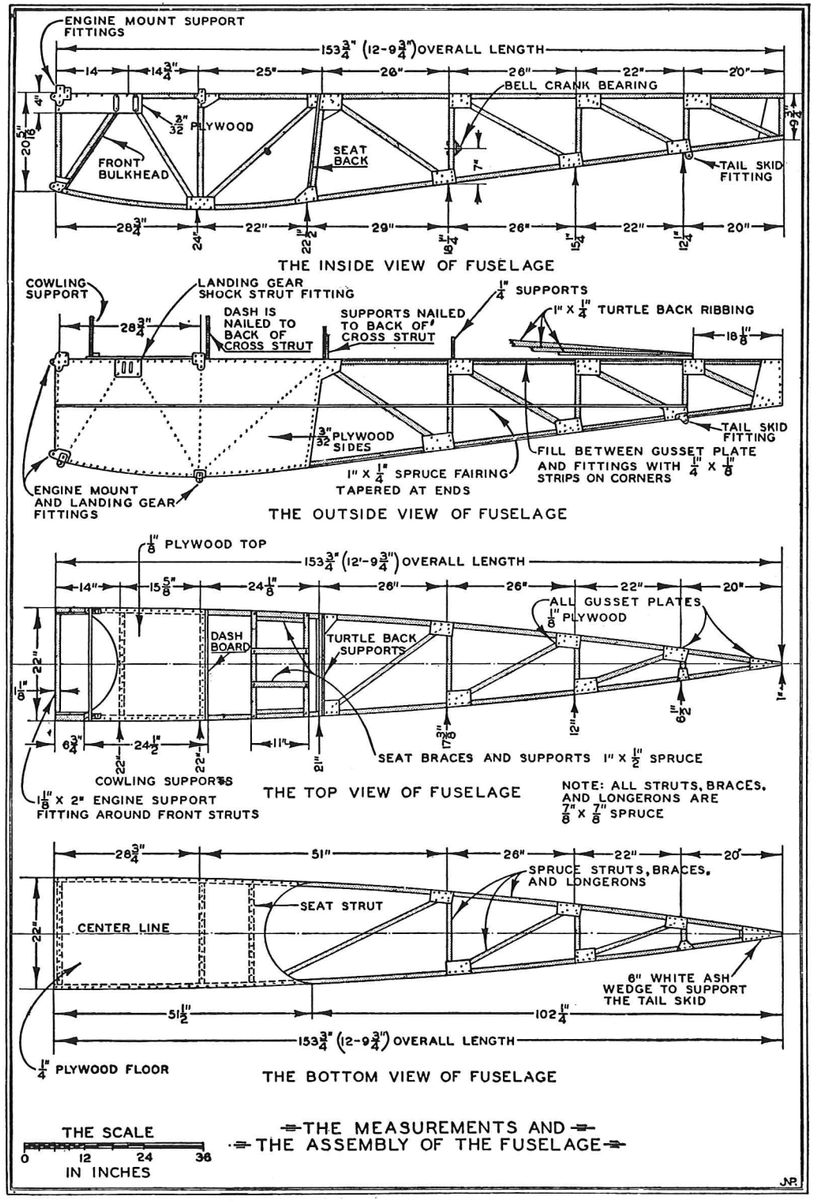
was about the same with all wings, and traveled back about the same amount for increased angles of incidence.

But while all the graphs of wing curves which I secured from the N.A.C.A. at Washington looked about alike, and had about the same characteristics on paper, there was a lot of difference in the way they handled. Slight differences in lift and drag characteristics on these graphs, which wouldn't seem to mean a thing, would mean a whole lot when put onto a ship.

You know monoplanes of the high-wing type are the strongest and safest from the aerodynamical point of view. Yet they handle differently than any type of airplane like a biplane. There is a sort of pendulum effect that makes it rock back and forth, and a wing section that doesn't have a minimum travel of the center of pressure will be bucky on the controls. That is all taken out of the Sky Scout through the use of our wing, but I often wondered why nobody had taken a crack at the subject. I know the M-6 wing section has no travel pressure, but it isn't so hot in the air alongside our section. And so that is that. •••



Up she goes! Don Finke taking off at the Wold-Chamberlain airport for a cross country hop.



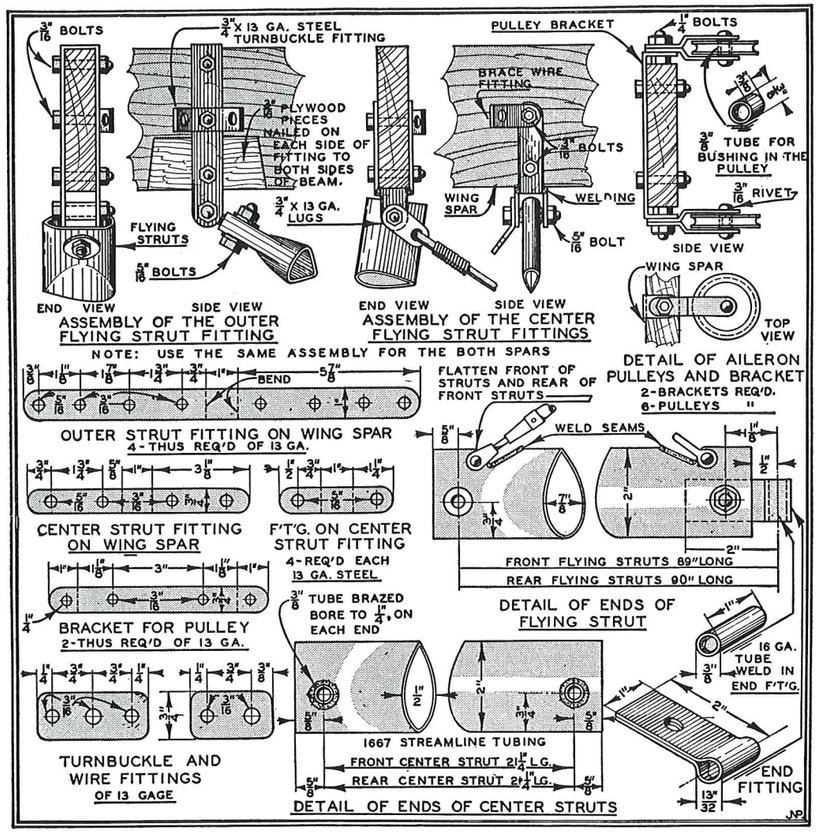
Dimensioned drawings of the Sky Scout wooden fuselage. It has been the experience of the designer that de Havilland type of wood construction is simpler to build and will stand up under the hardest usage. This job is a marvel of strength.

MANUAL) I'll retell the history of this wing curve of ours.

I've been building airplanes for the last 12 year, you see, and the first one I started was a biplane which was powered with a Ford T. She flew nicely, but in those days we hadn't heard of modern high-lift wing sections, and the underside of everything flying was as curved as a shoe horn, and not a lot more efficient, either. I think the wing curve I used on that first ship was a U.S.A. No. 4, which was supposed to be the hot-test pepper out at the time. Then I used other wing sections on other ships, and found out a lot of rule of thumb things about them which any ham mechanic knows.

That is, that within limitations the center of pressure of almost all wings varies from about a third of the chord from the leading edge to about 40 percent at the very high angles of incidence. I know there are wing sections with negative angles of incidence, but they are mostly freaks — I am talking about normal wings. The center of pressure

Here are the details of the center section struts and the aileron pulley fittings. These drawings need no explanations.



our ships.

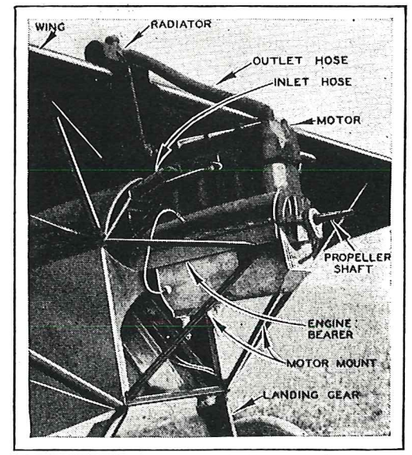
The magneto is driven in a left hand direction, direct from the crankshaft.

Better use a good mag, as I have seen a lot of the old D U 4s go bad when they are flown in hot weather. Also, a new mag weighs about 7½ lbs. where the old ones weighed about 14 lbs. Although we have one of the old mags on a ship at present, and it seems to work fine. The propeller hub is made as on the model A, except that it is necessary to use a nut on the engine side as the flange is not threaded.

We use a gear driven oil pump from an old Ace motor, built by Horace Kean in New York about 1919. We have a hollow drilled shaft and carry three quarts of oil, although any good oil system will work. Don't favor splash so much for model Ts as they have bent hair pins for crankshafts and the bearings are small, although the shafts are built of the best stuff money can buy for crankshafts.

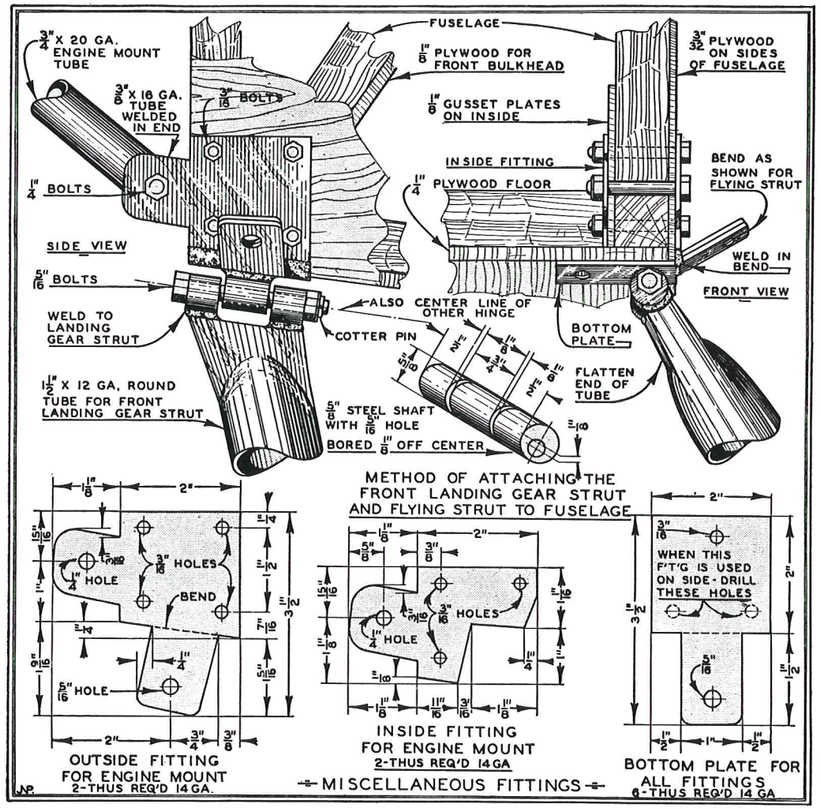
Thermo-Syphon Cooling

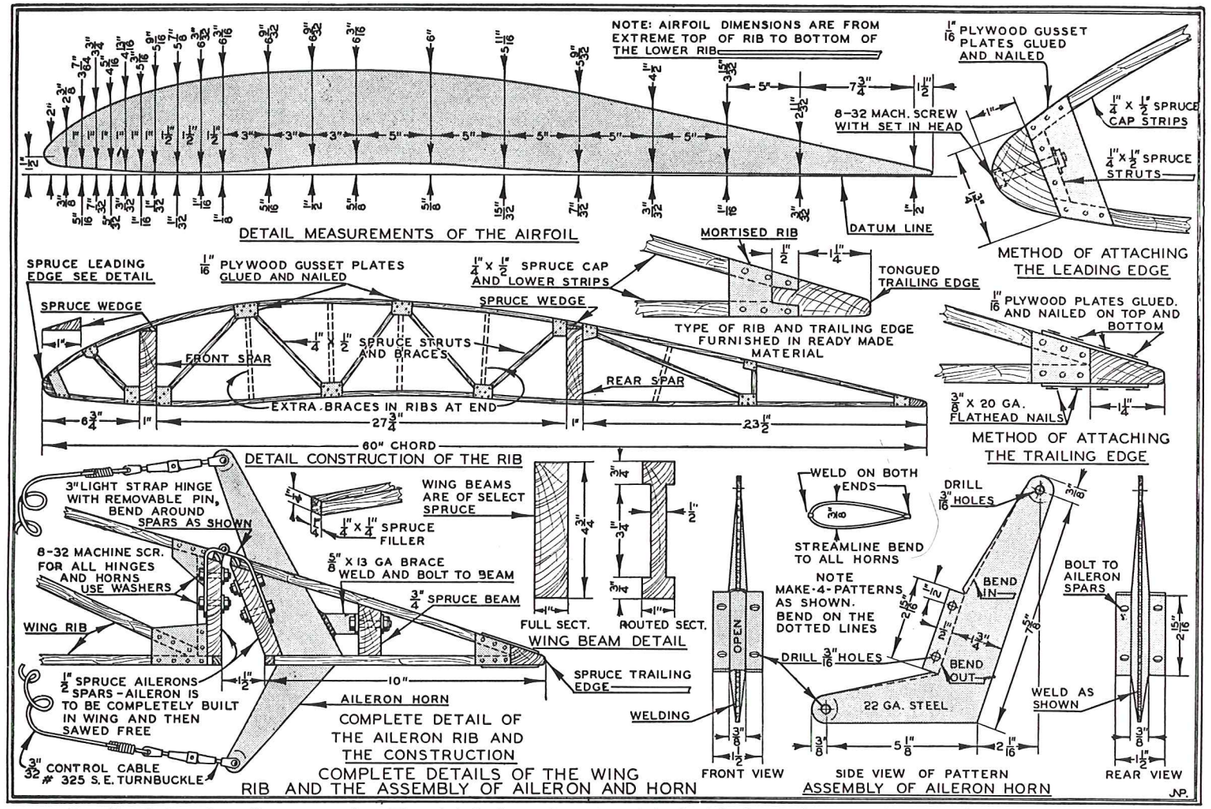
The thermo-syphon system is used. The block is fitted with a 1½ in. outlet near the top front of the motor (see drawing) opposite the place where it was on the motor, and this runs to the radiator top. A circulating pump could be used in warm



This will give you an intimate glimpse at the salient points of the T conversion as used in the Sky Scout. The McCord radiator, bearing lubricator and other parts are shown as per drawings elsewhere in this series.

The same sturdy, ample fittings of simple design are used on the Sky Scout as were used on the Air Camper, with only minor changes. All bends must be made slowly, and done cold. It's important that all welding be well done.





Details of the wing rib construction. The airfoil shown here is original with the designer, and is exactly the same as that of the Model A Air Camper. Construction is a trifle heavy, but the ship has been designed for safety rather than speed.

weather, and would be better, but we have had no trouble as on one instance Don Finke flew a ship from Spring Valley, Minn., where we have our shops, up to Minneapolis, a distance of 150 some odd bee line miles, and he ran into some hot, dry weather, then a thunder and rain storm. The motor never coughed, but kept slamming along.

The radiator was made from a 1926 Macord Ford radiator cut in two and one half put in back of the other. This makes a better looking job. Better have a tinsmith do this job well for you. In regard to the radiator, lots of those building the Air Camper asked why I did not put the radiator below the fuselage. We have tried this on two ships and in both cases the climb of the ship was poor, the top speed five miles less. The motor overheated, and the draft and lack of supporting wind stream made the ship very tail heavy. Carried a passenger with difficulty and weighed more, and the same would hold true on the Sky Scout here.

The vision on these ships is good and the radiator does not bother. In fact, the vision is better than one of the Air Campers using a Velie motor.

It will not be necessary to use a new Ford T block for the ship. We can arrange a regrind job at a dollar an inch of bore on any old block, so that the new aluminum Ritefit pistons, which must be used anyway, can be cut to fit the new job just as well as an old one. Old T blocks used with the cast iron pistons very soon run out of round, and are hogs on oil as most of you know. With aluminum pistons cut with .007 in. skirt clearance and .025 in. head and ring gland clearance, the oil pumping and the blow-by compression losses are cut way down. The pistons are sold in the rough and are fitted for any prescribed diameter at the time of selling.

Here are some of the salient figures that readers will be wanting in connection with the motor and the business end of the ship. The weight of the prop is about 12 lbs. The weight of the motor dry is about 185 lbs. The weight of the radiator is 15 lbs. The job holds 4 qts. of oil which weigh 7 lbs., and the cooling system holds 3 gals., or about 20 lbs.

I would say that this four is about 32 hp. It turns a Lawrence prop 1500 rpm and the government figures show that this prop requires 28 hp at 1400 revs.The model A will not turn this prop over 50 turns faster.

The propeller is 6 ft. diam. by 42 in. pitch and turns anti-clockwise. This is a Flottorp prop. It will turn from 1650 to 1740 on the ground, depend-

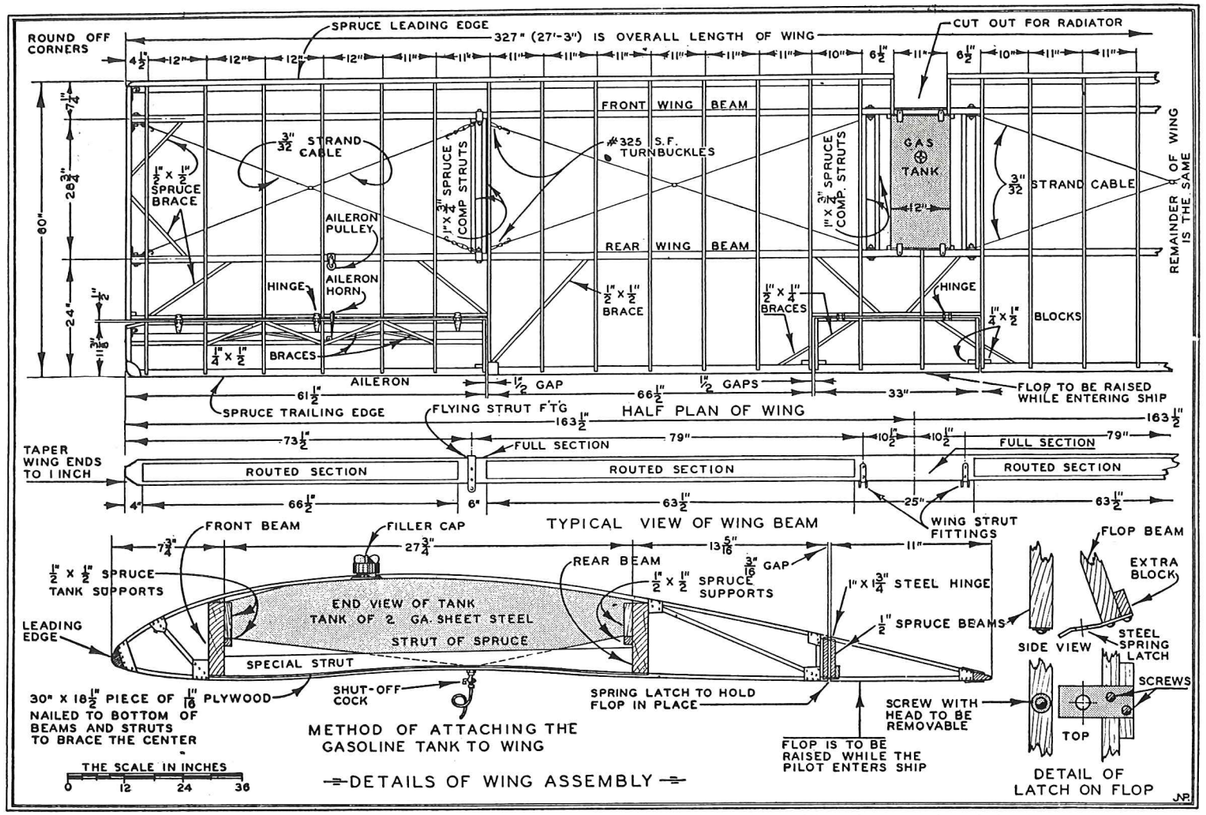
tight until you get in your compression struts and wing tips.

Now put on leading edge, trailing edge, aileron beams, flop beams, and wing tips in order named. Line the wing up so that it is perfectly straight and put in all braces in wing (wood) and also put the ½ in. by ¼ in. braces on the ailerons and put all filler strips on the aileron hinges (which are only small strap hinges with a new pin put in which has a cotter pin hole in its end).

Now place the control horns, and you are ready to cut the ailerons and center flop from the wing. By leaving all the ribs full length and cutting the ailerons and flop free when finished you are sure to get a better and straighter wing. After you have all the parts finished and sanded you may give the whole thing a coat of varnish.

This wing is as strong as I know how to make a wing without having a lot of needless weight. We experimented a lot with wings on the good old Air Camper, which still is the best ship today for the model A Ford motor. We looked at planes with a lot more load per running foot of spar length and a lot more load per square foot of wing, and made our spars and ribs to conform. We found only one flaw in years of flying the A jobs and that was the trailing edge of the wing was a little weak for stunting. Don came sailing into the field with his job one day in a steep side slip — so steep I thought he'd hook a wing and flip over. Boy, he was going, and he yanked her out to see what would happen. Due to the fact that the little cross members in the trailing edge were in the wrong direction, a portion of the trailing edge folded up, but it didn't seem to hurt things any, and he flew the rest of the day before we started to fix it. That shows the extreme confidence we have in the ruggedness of our ships and I hope my telling this will convince you of our candor in perfecting the little things. We went through our analysis again, and found it would make the rear edge of the rib a little stronger to run the piece the other direction, taking the load in compression instead of in tension, and we have done so in this Sky Scout design. I'm still sticking to our home brew wing section and I will until I can find something that will work better — so far I haven't found it.

For the benefit of those of you who have not read of how we constructed the Ford A job (which article appeared in the last issue of the FLYING



Details of wing assembly are given on this working drawing. The method of installing sheet steel tank in the center section of wing is clearly shown here. Another interesting innovation is the flap at the trailing edge of the center section.

lbs. complete. It was only built this heavy because all the regular parts to build the Air Camper wing were used.

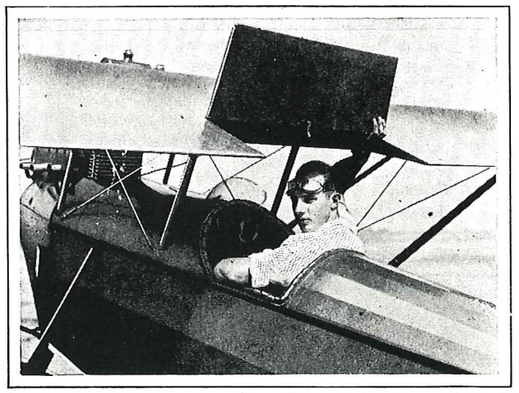
I wish to call your attention to the brace right back of the rear beam. This was changed from the plans of the Air Camper, and I advise all of you who have not built up your wing ribs to build them this way.

After your ribs are finished, make your beams (if you have trouble doing this, we will be able to make them for you) and splice them in the center. Now mark off all places where the ribs will come, having the two beams clamped together.

A good way to do this is to mark off the places on half of the spars, then reverse one beam and mark the other half from the first marks. You will then know that it is right.

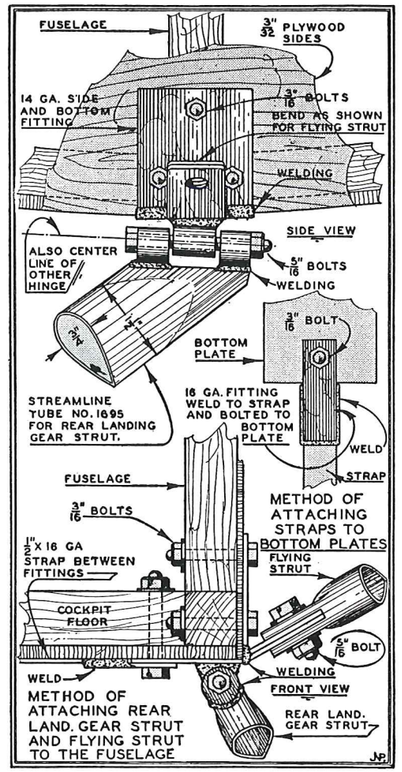
Next glue in the piece of 3/32 in. or 1/8 in. plywood that is set beneath the gas tank, and be sure you have this in the center and perfectly square, as the whole wing is lined from this center. Now put on all the ribs and glue and nail them with two 1 in. by 17 gauge nails at each joint. On the top it will be found necessary to put in small spruce blocks to fill up the gap. These must be glued on both sides.

Next put on all wing fittings and brace wires (we use 3/32 in. cable as it is easier to handle, although No. 12 hard wire is O.K.), and line the wing up with the wires. Do not make them too



Don Finke demonstrates the utility of the flap, which is necessary for easy entrance and egress. Photo also gives you an idea of the plane's visibility.

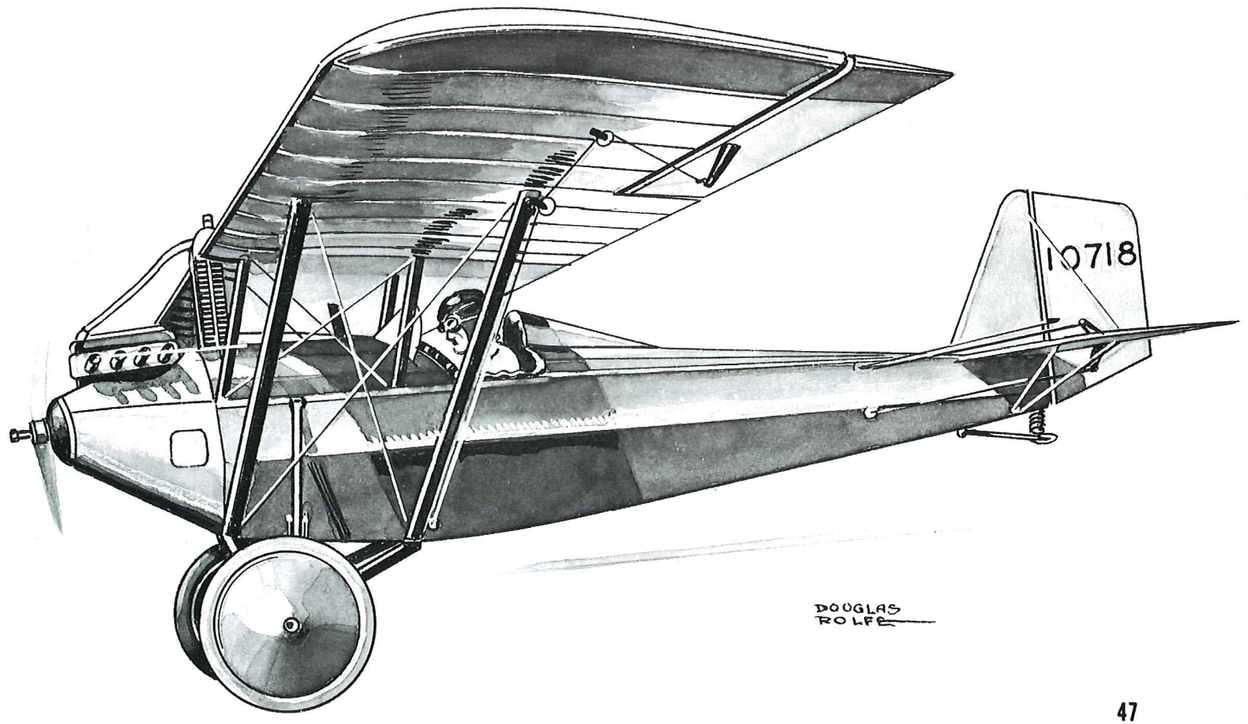
Here are the details for the fittings used on the fuselage end of the new V-type Pietenpol landing gear. All bolt holes must be snug fits.

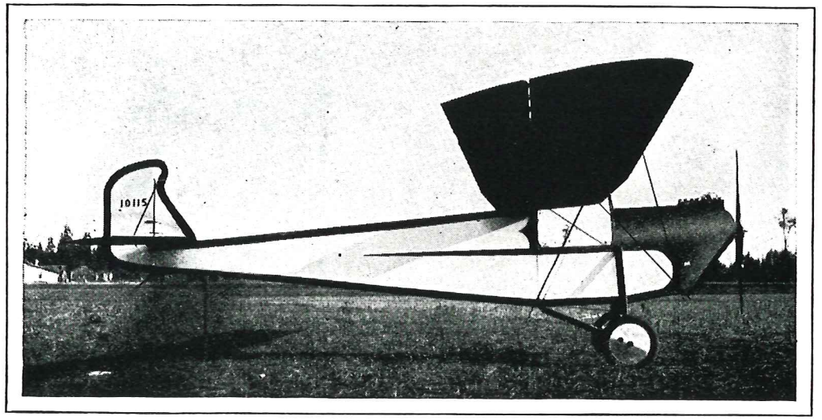


ing on the day. It cruises at 1600 to 1650 in the air and will turn 1850 in the air wide open.

The weight of the fuselage less cloth and metal fittings is 43 lbs. with turtleback and instrument board. The weight of the tail unit less cloth and horns is 9¾ lbs. Each landing gear V weighs 5 lbs. Shock struts weigh 3½ lbs. each. Weights of other components have been given in other installments.

• • •





Driggs, Aeronca and many others use the familiar triangular fuselage aft of the wing. Long has adapted it again in this latest version of what he believes a good lightplane should be, and the beautiful result is apparent in this photo. Note the sweet lines, the apparently rugged undercarriage, and balanced rudder.

THE HENDERSON LONGSTER

The designer of the famous Anzani Longster, one of Modern Mechanix and Inventions' most popular designs, comes through with his promised version of the Longster lightened for Henderson use. The ship is remarkable for stability and flyability.

By LES LONG

After the rather surprising success we had with the *Anzani Longster,* it was probably only natural that we should turn to the popular little Henderson as the power plant for a still lighter and cheaper Longster. This little engine undoubtedly holds first place in the affections of the lightplane clan, and well may it do so.

The Henderson is undoubtedly a little low in power for the average amateur ship, said ship generally having a tendency to run into pounds. However, we decided to make a try at it and the results were far more than we had hoped for.

This new ship has about everything that could be asked for in a real lightplane. It is reasonably fast, 75 mph at 2,850. It has a good steep climbing angle and keeps right on climbing, seeming to do as well at 4,000 ft. as near the ground. It lands at exactly 25 mph in still air, measured by cars running along beside it.

Its gliding angle is fully 12 to 1. You should hear the pilot talking to his friends on the ground. It rolls, banks, zooms and does wing-overs with such apparent ease it is a joy to watch. As to stability we can only say that it has been flying for two months, most of the flying being done by beginners, and has never made a bad landing nor damaged so much as a bolt or flying wire. Parasol type planes are notoriously easy to land. It will fly for miles with the controls entirely free, and *will right itself from any position.*

As to power we can say that we fly the ship regularly with the motor turning 2,100 to 2,200. It will actually climb with the engine running 1,900, believe it or not. This is with a propeller of 4 ft. 10 in. diameter and 30 in. pitch. This prop turns 2,950 at full throttle, which certainly leaves plenty of reserve.

As is customary, we shall start out with the wings. The ribs are the usual strut and gusset type, the rib stock being ¼ square spruce and the gussets 1/16 plywood, birch preferred. Make up the usual rib jig on a smooth board, being careful about accuracy. The curve is the standard Clark Y. Instead of nailing one side at a time it is

3/32 in. mahogany plywood. The floor is made of ¼ in. 5-ply haskelite. All gusset plates of ⅛ in. material. Remember, all plywood must be regular aircraft grade and waterproof.

Use a good glue. We use Rodgers semi-waterproof and give it two good coats of varnish. You may use regular casein glue, but be sure you know how to handle it. It won't keep long (12 hours).

Make Jig for Fuselage

You will need a large bench on which to draw out and build your jig. We use the same jig for both sides.

Each strut is held in place by blocks which are left nailed down until both sides are finished. Also leave the longerons a little long, and wrap some wire from the top to bottom longerons, twisting it tight with a nail until you have the plywood nailed and glued on each side. When the glue is dry you may saw off the longerons in front.

First lay out one side in the jig, putting in all struts and braces. When you make one strut, make another just like it to be used on the other side so the two will be exactly alike. Be sure to use a miter box for this work.

Next glue and nail on all the ⅛ in. gusset plates, wire the front longerons together so they will not spring apart and break the gusset plates.

Now remove the side from jig, put the longerons, struts and braces for the other side into the jig, and put the gusset plates, starting from tail and working up to where the 3/32 in. sides start.

Now take the side you have just finished from jig, lay it in on a piece of 3/32 in. plywood, and mark out all longerons, struts, and braces by running a pencil around them, then cut the plywood the size of fuselage. Make two of these — one for the right and one for the left side.

The side of the plywood bearing the pencil marks goes on the outside, and gives you good marks to keep your nails between.

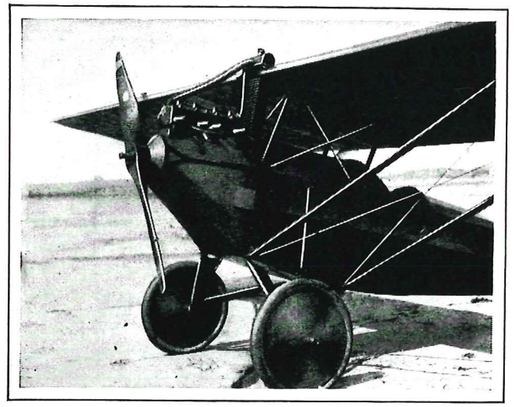
Glue and Nail Gusset Plates

Now put a good layer of glue on longerons, struts, and braces as far back as the plywood goes; lay on your plywood and get busy nailing it down with ¾ in. by 18 gauge cement coated nails. All other gusset plates are also put on with this size nail.

When you have this done, wire front of longerons together and remove from jig. Now remove all blocks from the bench so that it is smooth. Turn the side of the fuselage over and put gusset on that side; then do the same with first side you started.

Now take the two sides and clamp them together. Saw off ends of the longerons exactly the same length. Take a tri-square and mark off all strut stations, the place for the instrument boards, and a few extra marks that will come in handy to measure from.

Now make the seat back and the front bulkhead. (These must be perfect, as the whole job de-



This excellent view shows the installation of the Ford Model T engine in the Sky Scout. Note location of the radiator and individual exhaust stacks.

pends on them) and nail and glue them in place. You may now put in the ¼" by 5-plywood floor, nailing it in with 1 in. 17 gauge nails. Next comes the top of the fuselage.

Now pull the tail end of longerons together, make this joint fit good, glue and nail it good, and put in all the rest of the struts and braces, using the center line method to get it straight. That is, make a line in the center of each strut and make a tight string or wire pass over this line when drawn from center of front to center of tail post.

The struts are next set on the gusset plates of the sides. Then put on turtle back, instrument board, cowling, and support and the woodwork is finished except for seat, which you should have no trouble with.

I can get the fuselage built up for you if this sounds like too much work, and then you will have a perfect job around which to build the rest of the ship.

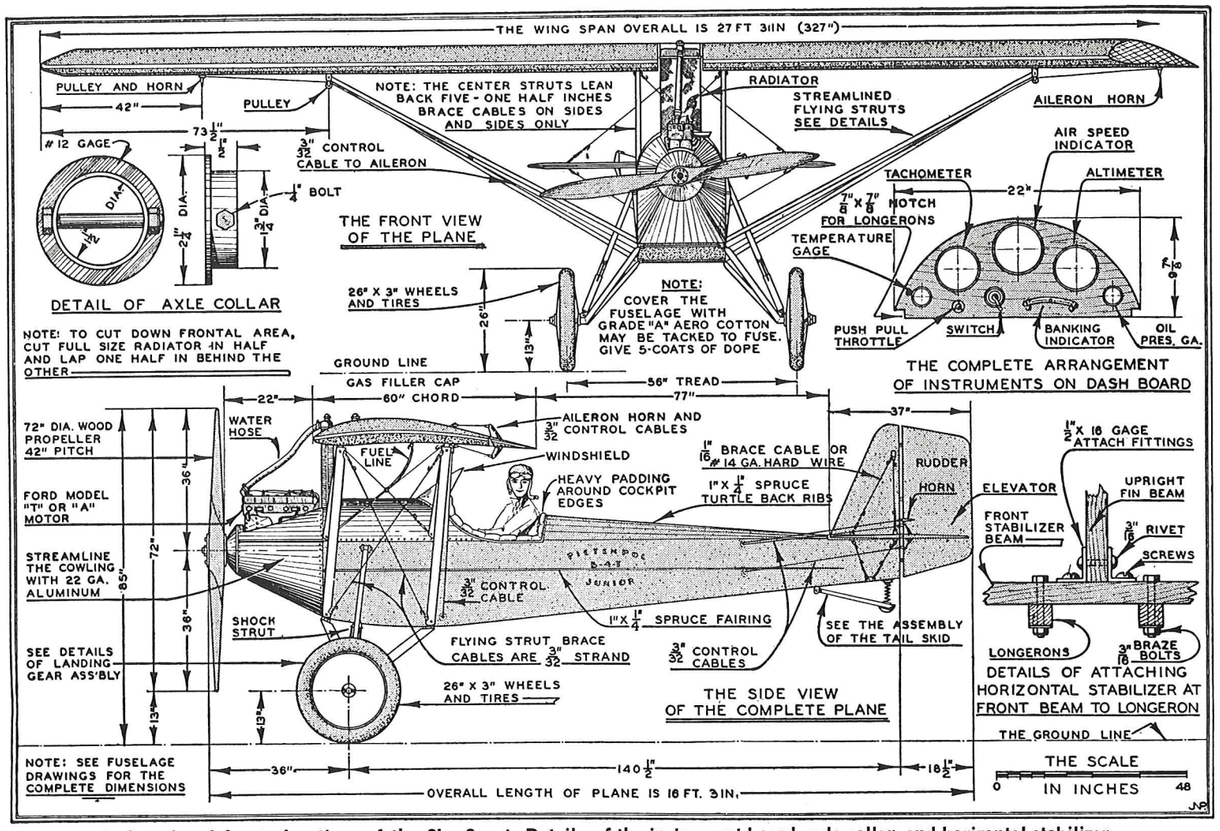
The Wing

The fittings are so clear on the plans that it would be a waste of time to say anything about them. They are all made of regular 1025 aircraft steel and are more than strong enough.

The wing on the Sky Scout is much too strong and could be lightened a little. It weighs about 90

SPECIFICATIONS OF THE PIETENPOL SKY SCOUT

High Speed	62 mph
Cruising Speed	55 mph
Landing Speed	35 mph
Take-off Run	150 ft.
Landing Run	250 ft.
Initial Climb	Minimum, 200 fpm
Span	27 ft. 3 in.
Chord	5 ft.
Length	16 ft. 3 in.



Outboard and front elevations of the Sky Scout. Details of the instrument board, axle collar, and horizontal stabilizer

some reserve power. The motor will turn as high as 1800 in the air.

Blueprints Correct

The editors showed me a set of blueprints that they made from the shop drawings that I used in building the ship, and let me say for the plans that they are exactly like this plane is built, and the most beautifully drawn up and easy to understand that I have ever seen.

There are a lot of improvements in these prints that will also be a great help to you if you are building the Air Camper.

Again I wish to say that these plans are exactly as the ship was built, and if we build any more of this model, they will be exactly like this one, as after flying the whole season of 1931 we have not found one improvement we would wish to make, and the plane is far better than we dared hope for.

So please do not write to have the design changed, as I advise that the ship be built as it is.

There are so much of the instructions printed right on the plans that it does not seem necessary to write a treatise on how to build it, but I will try to give a few pointers that will be of help to you.

Designed for Easy Building

The Sky Scout was designed to be as easy as possible to build; but unless you know you are capable of building a plane, or have someone to help you that is capable, please do not try to build any airplane.

I believe this is the easiest ship to build there is. However, I wish to have only safely built and good flying planes in the air, and if I knew that any unsafe ships were built from these plans I would prefer that you had never seen them.

I believe that this is the safest plane for the beginner that has ever been built. It is for the fellow who is going to build his own ship that these plans were made. All of us who are interested in aviation have to make a start some time and I think that building your own lightplane is the best way to get started.

The Fuselage

We will now take up the construction of the fuselage. This is very plainly drawn up and I do not think you will have any trouble with it. It is made from 7/8 in. by 7/8 in. spruce, for longerons and struts, while the sides and front are covered with

best to place gussets with glue applied on both sides of the joint and nail clear through, clinching the nails after removing from the jig. Use casein glue and ½ by 20 ga. nails. Note that the aileron ribs are slightly different, the little strut to the rear of the rear beam opening being set back is shown by the dotted line. Count your ribs carefully to avoid duplication of effort.

Spars

The spars are of the I beam type and are of selected spruce. It is best to have them cut and routed at a planing mill, although they may be built up with 1 in. by 20 ga. nails and glue if desired. In any case be sure the wood is free from all defects, including crooked grain.

When the spars and ribs are ready assemble them, taking care that the aileron ribs are in their proper location. The butt rib is a special one, made up with ¼ by ½ caps and one side covered with 1/16 plywood. The reinforcing blocks must now be placed. They are all of ¼ plywood, except at the wing butt. The long ones at the flying wire position are notched as shown and the others are plain blocks, 4 in. long and of the proper height to fit in between the spar flanges. Blocks are placed on both sides of the spar, glue being applied first.

Butt Blocks

The blocks at the butt are special and require a little explanation. It will be seen that the wing hinges of one wing straddle the hinges on the other, and must therefore be farther apart. We will choose that the hinges on the left wing have the wider separation, therefore the plywood on the four spars will be as follows:

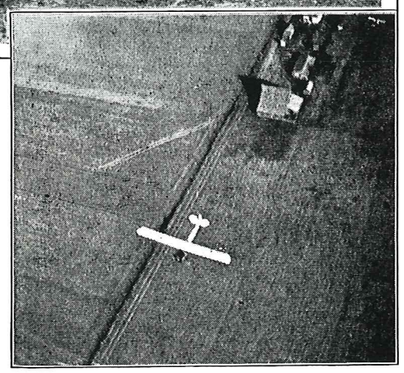
On the right front spar the plywood is 3/16 thick, one on each side. This separates the straps ¾ in. On the right rear spar the plywood is ⅛, making a spacing of ¾ also. On the left front spar the plywood is ¼ thick, and on the left rear spar it is 3/16, which separates the straps on these beams ⅞ in. Therefore, the straps on the left wing will just straddle the straps on the right wing. This sounds worse than it really is, as the drawings will show.

Bracing

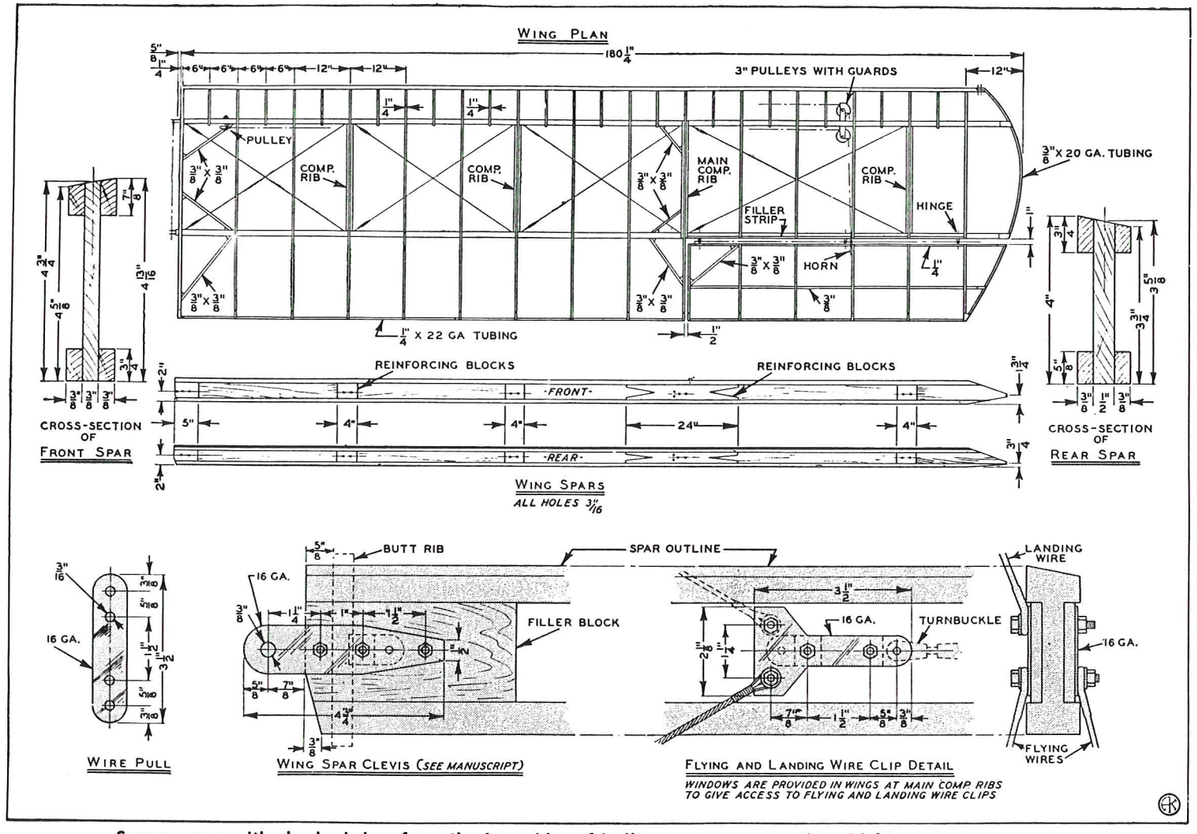
The drag bracing comes next. The wire is No. 12 hard aircraft wire and the turnbuckles are No. 325. The compression ribs are the regular ribs, but with a ⅜ in. by ¾ in. spruce strip nailed and glued on each side. The ends of these strips butt up squarely against the wire pulls. The pulls are slipped in between the rib strut and the reinforcing block on the spar, and are bolted firmly with 3/16 in. aircraft bolts. The main compression ribs at the flying wire location are like the others, but have ⅜ in. by 1½ in. strips on the sides and also have an extra cap strip nailed and glued on each



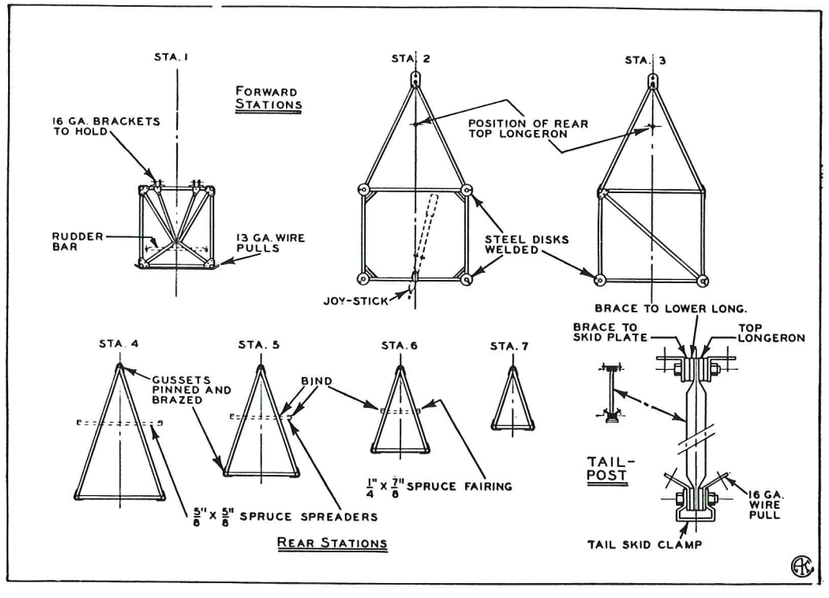
The Driggs, the Aeronca, the Heath and others which have a lot of flying time behind them are all of practically the same proportions. The Henderson Longster bears close resemblance in appearance and good flying qualities.



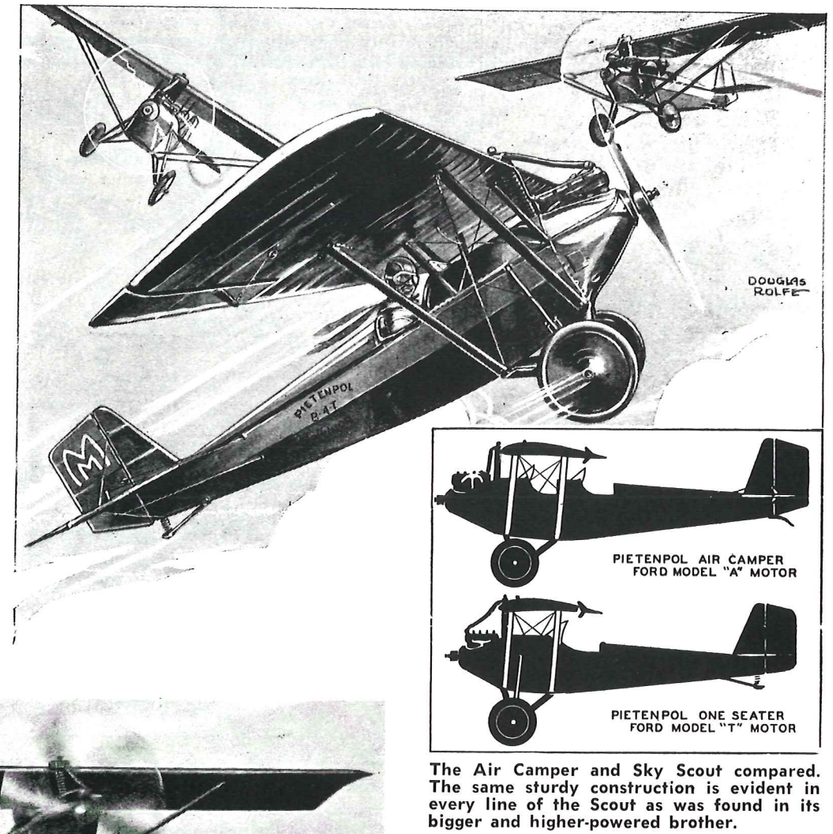
Here's the Henderson Longster snapped on a cross country hop in Oregon. This picture was snapped from a Waco OX5, which has about the same flying speed as the Longster. Oregon is good flying country, to judge from the looks of the terrain.



Spruce spars with cheek girders form the Long idea of built-up spar construction. Light, very strong and good.



Here we see the method in which Long trusses the fuselage. Note placing of fittings and way in which ¼ in. by ⅞ in. spruce fairing is placed about the turtle back. Fittings for tail skid and stabilizer are shown in the detail at lower right hand corner.



The Air Camper and Sky Scout compared. The same sturdy construction is evident in every line of the Scout as was found in its bigger and higher-powered brother.



The Pietenpol Sky Scout taking off from the Wold-Chamberlain airport at Minneapolis, Minn., for a cross-country hop.

plenty strong for this engine, and cowling and all will fit.

Now a few words on what the Sky Scout is:

First, the ship was designed to be as easy to fly as it is possible to make it. I have never flown a plane that handled better. It is also almost impossible to hurt it landing.

I have watched two fellows make their first solo on this ship, and if ever a plane had a reason to crack up, it did when it landed about 20 ft. up and pancaked down.

I have watched students fly into the ground with the tail skid two feet in the air, and have also watched the tail skid strike the ground when the wheels were two feet in the air on a stall landing.

The ship now has about 100 hours of this sort of time. The only thing that has been hurt is one vee on the landing gear that was bent a little on a forced landing made down wind when one wheel went into a sharp ditch (it did not nose over).

I also saw this ship land on a plowed field O.K., although it was necessary to pull it on to a solid field to take off as it could not move an inch on its own power — the field was too soft.

Now do not think I advise you to do these things, as I certainly do not. But it's comforting to know that your plane can stand this kind of abuse without cracking up.

The Sky Scout has a climb of at least 200 fpm, although it has been climbed at around 500 several times. It has a top speed of about 62 mph, a landing speed of under 35 mph, a take-off run of 150 ft. on a good field, and about 250 ft. landing run.

We let the motor turn a 6 ft. propeller with a 42 in. pitch, 1740 maximum revolutions per minute on the ground, and cruise the motor at between 1500 and 1600 in the air. The throttle is about one-third open at cruising speed so you see you have

PART 1

Plans for the Pietenpol SKY SCOUT

Since plans for the Pietenpol Air Camper were published just a year ago, several hundred sets of blueprints have been purchased, and those who followed the plans closely were, without exception, successful in building a safe and economical airplane. Owing to the insistent demand of lightplane fans for a similar ship powered with a Model T motor, the originator of the Air Camper has designed the Pietenpol Sky Scout especially for readers of the 1933 Flying Manual.

By B. H. Pietenpol
Designer of the Pietenpol Air Camper

No sooner had my article on building the Air Camper appeared in *Modern Mechanix and Inventions* than the readers began flooding both myself and Andy with queries as to whether the ship could be powered with a Model T motor.

Unfortunately I had to tell the fans that the Model T was hardly powerful enough for a two-place job. And then the fun began! Letters started pouring in, asking for plans for a one-place job that could use the main-spring of an old Henry. Well, here we are!

But, before going into the actual construction of the Sky Scout I wish to say a few things about the ship, how it happened to be, what it will do, and what not to expect of it.

Back to the Model T

I have been experimenting and building lightplanes since 1920 and my first ship was a biplane powered with a Model T Ford motor. The ship was very light, but not very strong, compared with the Sky Scout. However, I did with that first plane what a lot of you who build *your* first ship will try to do. I mean teach yourself to fly.

The plane was fully able to fly as I had it in the air about 20 times, but as I didn't know how to land, I busted something every time I had it up.

The last time I tried it in a 25-mile wind and there was not enough left of the crate to fix it up after that.

Learn to Fly First

So my first bit of advice is, by all means learn to fly before you try to take your own ship into the air. While I started flying with not over four hours and twelve landings, and soloed and test-flew a ship at the same time, I surely advise you against that method. But where could you find a school in 1920?

I then went in for higher powered jobs, but always believed that the Model T motor could be made to fly successfully.

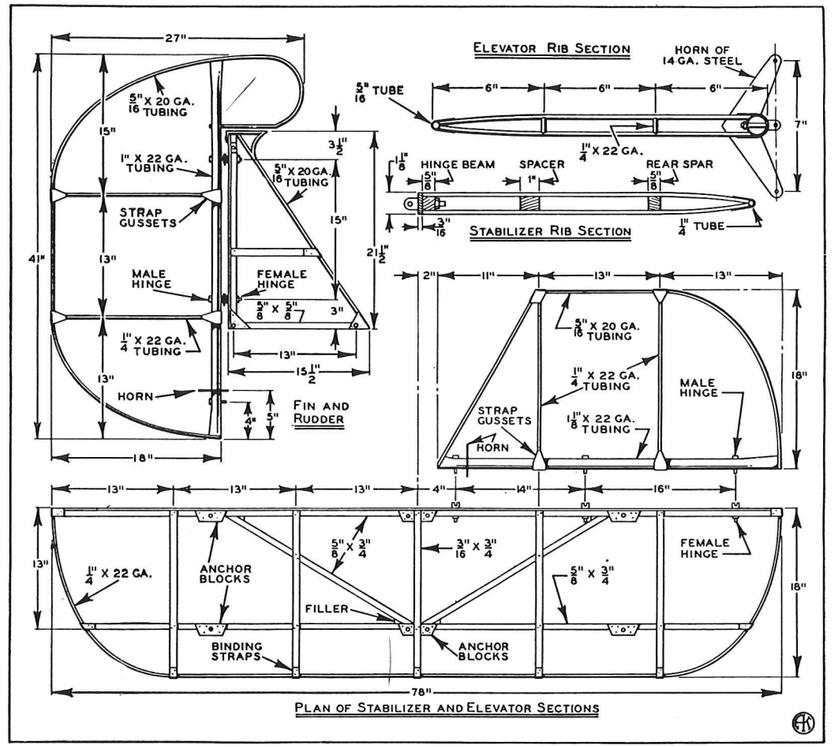
About in 1928 when the new Ford came out I decided that the Model A was the engine I wanted, so I bought all the sample parts from the Ford dealer and assembled a motor, although I had not seen the inside of the new Ford. The ship flew and was a success from the start.

Model A Gets All Credit

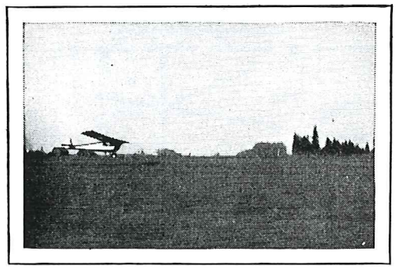
There was only one thing I did not like about this — the motor got all the credit, and the ship got none. So when the editors of M. M. told me that they could use a similar ship that would fly good on a Model T motor, I built the Sky Scout to prove to myself that I could build a ship powered with that motor which would be practical, and also to prove that the Model A engine was not the only automobile motor that would fly successfully.

The Model A is a wonderful motor for the small plane, and may be used in this ship, and advise its use if you have not a Model T all rebuilt for aircraft use. There must be hundreds of them built up.

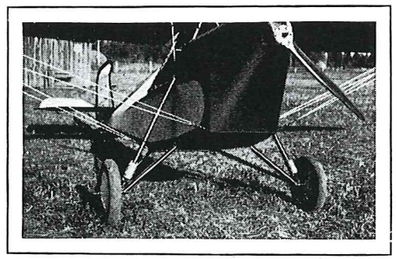
The only change needed if the Model A motor is used is to move the wing about one inch ahead and put on a little larger radiator, as the ship is



There's nothing radical in the construction of the stabilizer and the rudder. The rudder is of steel, and the stabilizer of wood, flat plate type. Drag struts of 5/8 in. by 3/4 in. spruce stiffen the stabilizer. Leading edges are of steel tubing.



No long waits for the ship to gather headway and roll a mile before she's off! The Longster jumps into the air on short notice and flies strongly. She has been rolled, winged over without difficulty and is thoroughly airworthy.



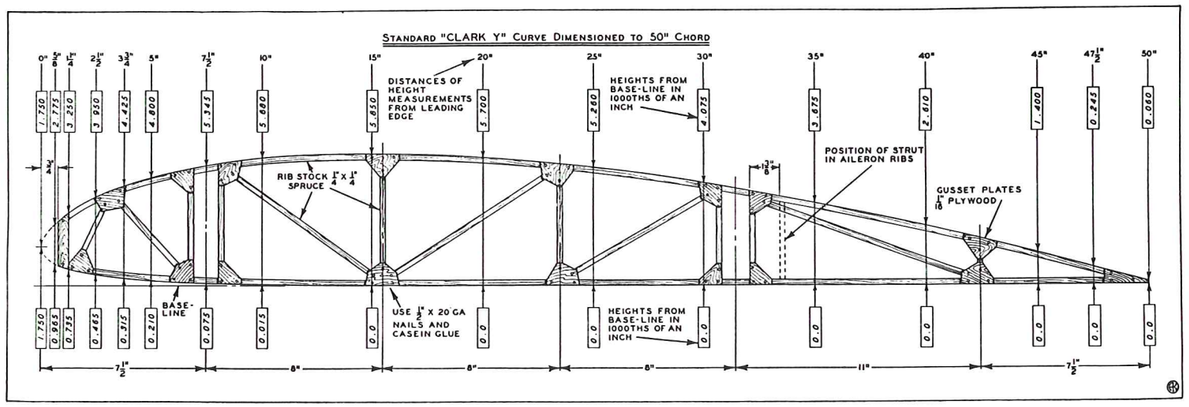
Any man who makes a bad landing with this ship should not fly at all. Visibility is par excellence, and the wide spread gear will tend to prevent shock and ground loops.

side of the regular caps, top and bottom. The wire pulls here and at the butt rib are small ones as shown by dotted lines.

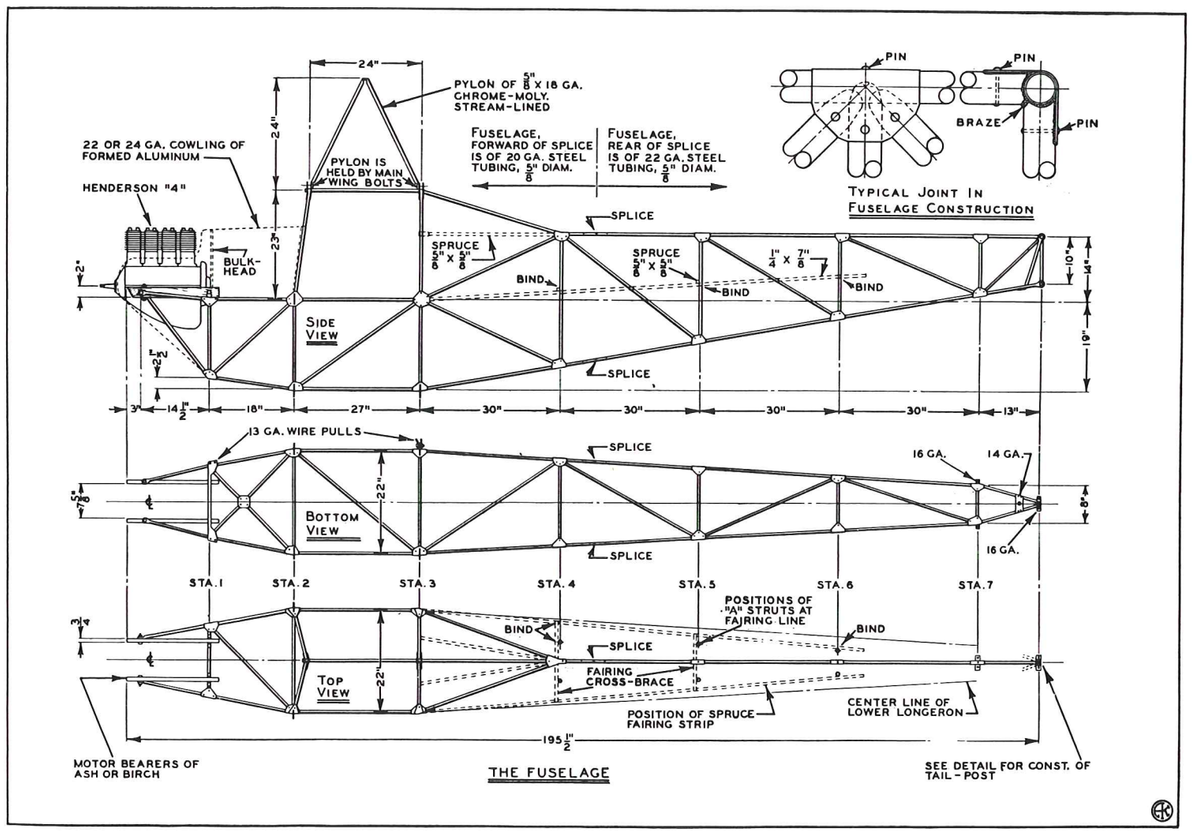
True the wing up perfectly square and straight and safety the turnbuckles. The ribs may now be nailed and glued to the spars, using 1 in. by 20 ga. nails. Shape the nose piece of light cedar or balsa and fasten with No. 3 by 1 in. screws and glue. Shape the two aileron spars and slip into place, after which they are glued and nailed. Apply the wing tip and trailing edge, using 22 ga. copper for the straps. After the straps are firmly nailed solder them to the tubing and also run solder over the nails. The aileron may now be cut out. It should be fitted with 3/16 in. eyebolt hinges and the horn should be made up and bolted on as shown.

The 1/4 in. square filling strips between ribs on the aileron and also on the rear beam at the aileron location are glued and nailed in. The two main pulleys are about 3 in. diameter and are mounted as shown, the brackets being made up of 16 ga. sheet. Be sure the pulleys line up and run free. They must also be fitted with light aluminum guards so that the cables cannot jump off. The small pulley is mounted about 10 in. in from the butt rib and is about 1½ in. diameter. It runs on a plain stud bearing which goes through the spar.

The corner braces are next fitted in and the

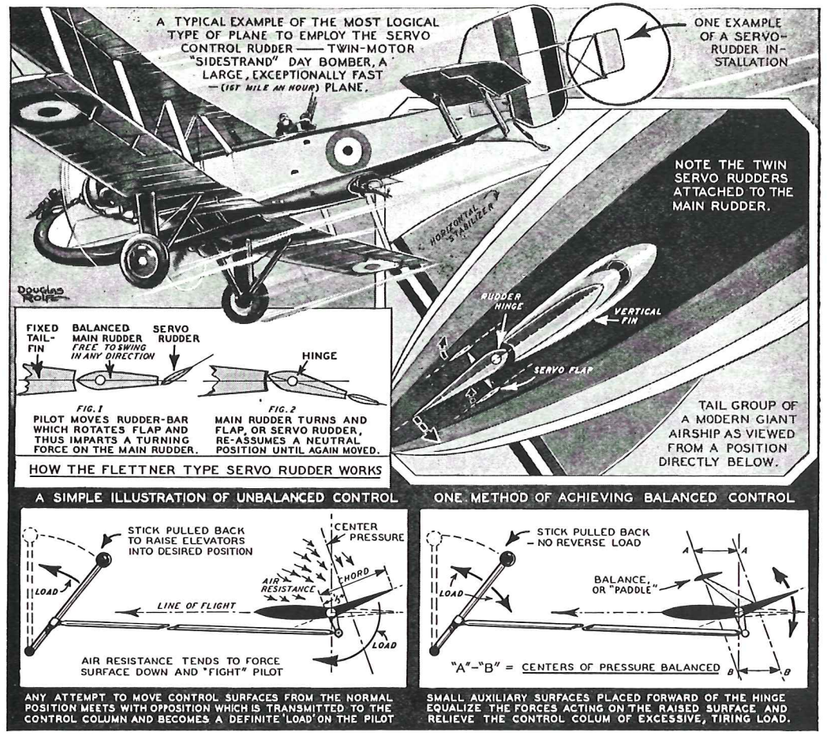


Here's your rib pattern, in decimals of an inch if you are that fussy. This is accurate, as it was drawn full size.



The Driggs Dart, Aeronca and others have used the triangular type fuselage with high success. The Long type of fuselage fitting and station brazing is well depicted in this drawing, which is fully dimensioned.

These drawings illustrate the methods of installation and principles of operation of the various types of servo-rudders. When the servos are moved the airflow creates a pressure on the rudder group which tends to turn the large rudder, thus taking the excessive strain from the controls. Servos are also used with success on the elevators of large airships.



Why We Have Servo Rudders

As long as airplanes and airships traveled along at fairly slow speeds and did not have extra large control surfaces there was not much difficulty in moving the surfaces out of the air-flow to get control. With the present large fast airplanes and the super-airships the movement of the control surfaces is fast becoming a back-breaking operation. Thus the pilots at the controls soon become physically tired from manipulating the controls.

On airships like the *Graf Zeppelin* and the *Akron* the control surfaces are tremendously large. To move them requires considerable force and auxiliary surfaces are used to make the movement easier.

When these auxiliary surfaces or servo-rudders are moved the air flow creates a pressure which tends to turn them back to their original position. However, as these small surfaces are held firmly in place, the pressure is transmitted to the large rudder, and thus its pull requires considerably less pull on the control cables. Large ships have servo-surfaces on the elevator as well as rudder controls.

The servo-rudders are mounted with separate control wires and are so equipped that they can be firmly held in any desired position. Thus they can be used to assist in turning the rudders and also in bringing them back into neutral position.

There is also shown an auxiliary balance surface attached to the ailerons. These are sometimes called aileron paddles. They are so attached that as soon as the aileron moves from a neutral position the air-flow causes a pressure against the paddle which tends to bring the aileron back to a neutral position. • • •

This is a subject that causes lots of different ideas too. Use a good grade of unbleached sheeting, double sew the seams and be sure and sew the cloth to the ribs, using tape over the ribs and at least five coats of good dope on the ship before painting.

Controls and Control Wires

Make up the stick as shown and don't put any gadgets of your own idea on them. They are O.K. as designed and work best for this ship that way. Don't slight this part of the ship, for it is *very* important that they work just right. The wires are made up of *Aircraft Flexible Cable,* not sash cord as a lot of the boys use, thinking that they are smart and pulling one over on the designers. It is a lot less in cost and *not just as good,* as some of the boys are now telling ST. PETER. Don't use sash cord for control wires. Also another thing about control wires is not to get them too tight or too loose, just snug so there is no play between stick and control surfaces.

The only instruments that are needed are the oil gauge, tachometer, altimeter and switch. Others are, of course, desirable, but you can buy what you want at the convenience of your purse.

Cowling

This is made of 22 ga. aluminum and carry out the lines shown to the firewall and then design your cowl to fit the particular motor you are going to use.

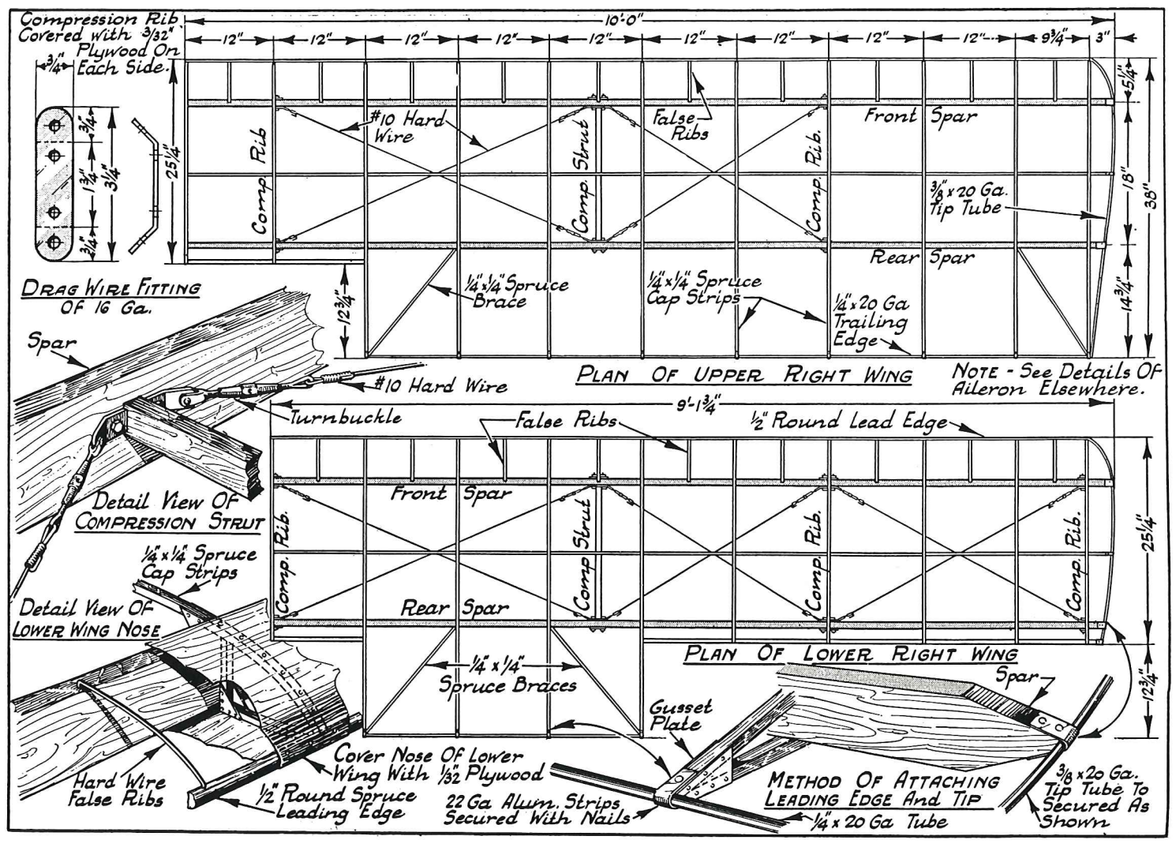
The floats can be built from the drawings shown, and so can the wings from my description.

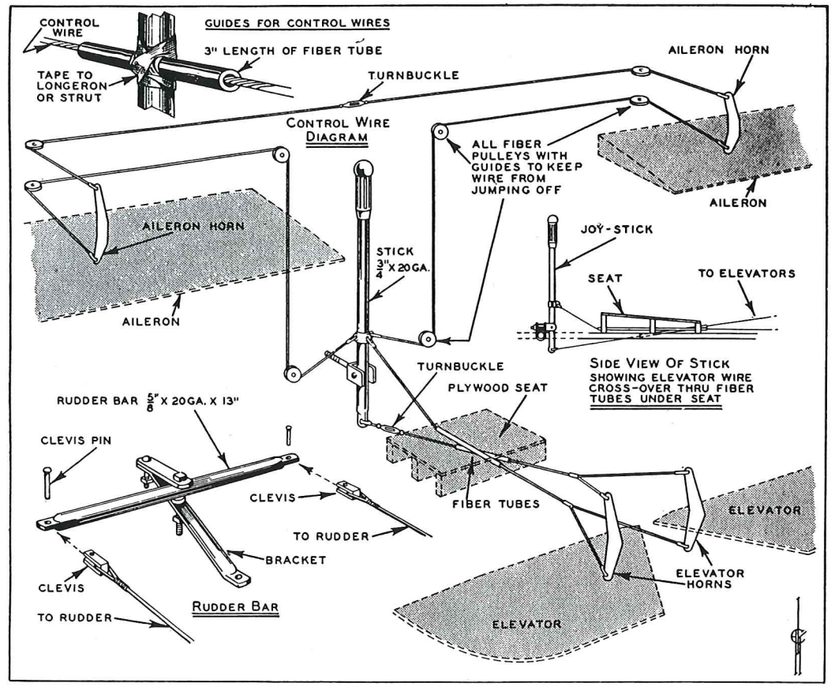
Use 3/32 in. aluminum rivets spaced at ½ in. along the lower lip seam where the sides and the bottom join and ⅛ in. rivets through the dural sides into the aluminum angles.

These angles you will have to make yourself on a tinsmith's brake.

I built a set last year and was going to use lighter gauge dural, but the stuff is hard and will get brittle if bent too much. So I substituted the heavier gauge soft aluminum and found that it worked well and was very stiff. •••

To anyone who has built a wing for a ship, the ABC simplicity of this design will be immediately apparent. Both upper and lower panels are shown, and must be built one right, one left for both upper and lower wings. Note simple compression struts





The manner in which Les Long rigs the controls of the Longster shows the ingenious and simplified way in which the joystick is made universal without a lot of expensive welding work or sheet metal fittings. Note axle weld.

little windows at the flying wire location are made up of ⅜ in. square stock. These window outlines are on the bottom of the wing only. The wing is now to be given two coats of clear spar varnish, covering wood and metal thoroughly. After it is dry it is covered with light airplane fabric, stitched and taped in the usual way. Give the fabric four coats of clear dope and two coats of colored dope or lacquer to suit your fancy. The Longster is finished throughout in silver with scarlet border striping. The completed wing should weigh between 33 and 35 lbs.

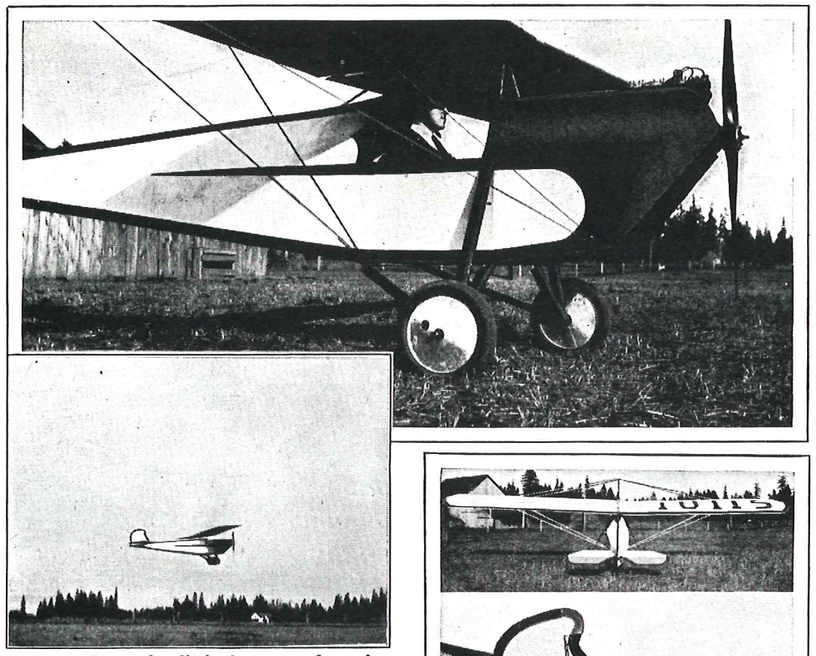
The next thing in order is the tail group. The drawings show the dimensions and sizes clearly so that little trouble should be had in building. The stabilizer is the usual wood construction with steel tube outline and the fin is of the same type. The elevators and rudder are of Chrome molybdenum tubing. You may either use the "braze and gusset" method as we do, or have them welded up. If you use gussets they should be of 20 ga. sheet. While the photographs show the rudder horn above the fuselage this was altered after the photos were taken, the horn being placed lower as shown in the drawings, making a much neater job. All hinges are of the 3/16 eyebolt type, bolted to the wood members and brazed to the tubing. Cover and finish as usual.

Driggs Type Fuselage

We now come to the fuselage. The design is the triangular type used in the Driggs Dart and the Aeronca. It is the lightest and cheapest possible to make. Before starting this we suggest that you get a copy of the 1931 Flying Manual. The article on the Anzani Longster gives a complete description of the joint used in the fuselage construction. Briefly, these joints are made by tack brazing the tubing together and then putting on a sheet steel gusset which is pinned to the tubing with small steel nails and the whole joint carefully brazed over. In three years use of this type of joint we have never had a single failure. The thickness of the gusset plate should always equal the wall thickness of the heaviest tubing in the joint group. If you prefer, the whole job may be welded up by a professional welder, but the tubing may not be as strong as in the above method.

You may construct this fuselage without a jig if you are careful. We did it. If welding is used a jig will be almost necessary. In any case make up the bottom first, tacking in all the cross and diagonal struts. Be sure to place the discs for the landing gear. Note that all struts that strike these discs are split with a hacksaw and slipped down over them up to the longeron. After the bottom is finished line up the top longeron and put in the side struts, working from a base line as shown.

Before the cabane struts are fastened to the top longeron you must see that the steel pieces for the wing attachments are slipped on. Steel discs like the ones on the lower longerons are also to be slipped on the stub longerons which form the top of the cockpit. These are for the top of the



Les Long hops the little Longster from her home tarmac in Oregon. Plenty of climb is exhibited in this "en vol" attitude, as Oregon pines must be hurdled!

A look at the shot left and the one to the side will prove that our nickname of "Flying Automobile" is not a misnomer. We have yet to see a ship of the light type which has so much real honest freedom from eyesore.

The cleanness of the Henderson Longster is well shown left. Below the balanced rudder and peculiar Long profile show the surfaces to be well out of reach of any but the longest grass. Note brace for the stabilizer plate.

landing gear struts. Check for squareness frequently as you finish up the fuselage. The bracing in station No. 1 is put in by flattening the members in the center, after which they are bent and arranged as shown. This arrangement allows full swing for the rudder bar. The support for the rudder bar is also attached to the flattened joint, the other end of the support being welded to the lower fuselage diagonals where they cross.

Motor Mount

The motor bearers are ash or birch and care must be taken to see that they are true and parallel with the imaginary base line. At station 2, corner braces are set in as shown to stiffen the fuselage against landing strains.

The landing gear should next be made up. It is similar to that used in the Driggs Dart and has proved quite satisfactory. The axle is 14 ga. and all the other tubing in the gear is 20 ga., all of chrome molybdenum. The stubs must be carefully welded to the rest of the axle and all joints in the gear must be reinforced by gusset plates. The rubber discs are 2¼ in. diameter by ½ in. thick and may be bought from any supply house.

The control system and seat must now be put in. The seat is of ¼ in. plywood and is placed on three ¾ in. by 1½ in. spruce stringers strapped to the lower longerons. This seat extends half the length of the cockpit and the balance is also ¼ in. plywood applied directly to the longerons. The next station forward is also floored in the same way. The stick is hinged to the center of the lower cockpit cross strut as shown. This causes the lower end of the stick to project below the fuselage a trifle, but is the simplest possible arrangement. The upper cable from the stick goes directly under the seat, the front stringer having a fiber plate screwed to it through which the cable runs easily. The lower cable slants up and goes through a similar bearing in the rear stringer. All cable except rudder cable is 3/32 in. flexible control cable. The elevator cables are made double for the rear half of their length, each of the four ends going to its respective elevator horn.

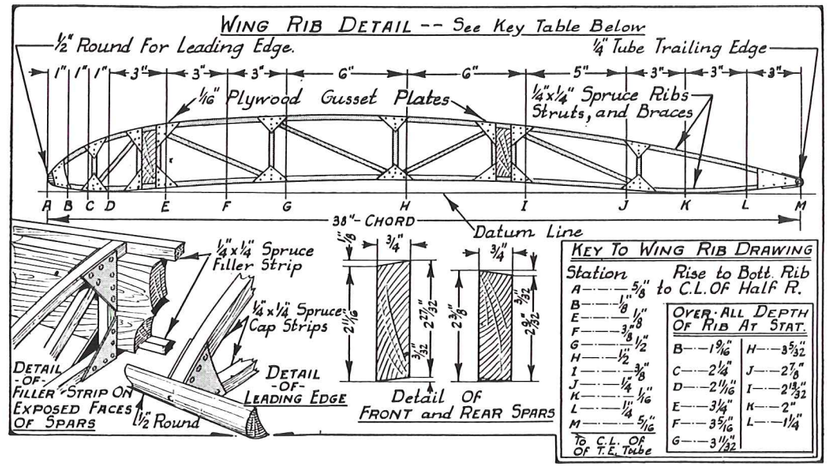
The aileron cables run from the stick to small, wide-groove pulleys at the lower corner of the cockpit, thence straight up into the wing and thence through the pulleys to the lower aileron horns. The cables must have been placed in the wing before covering. The return cable runs through the nose ribs, with a shackle splice at the space between the two wings. The rudder cables

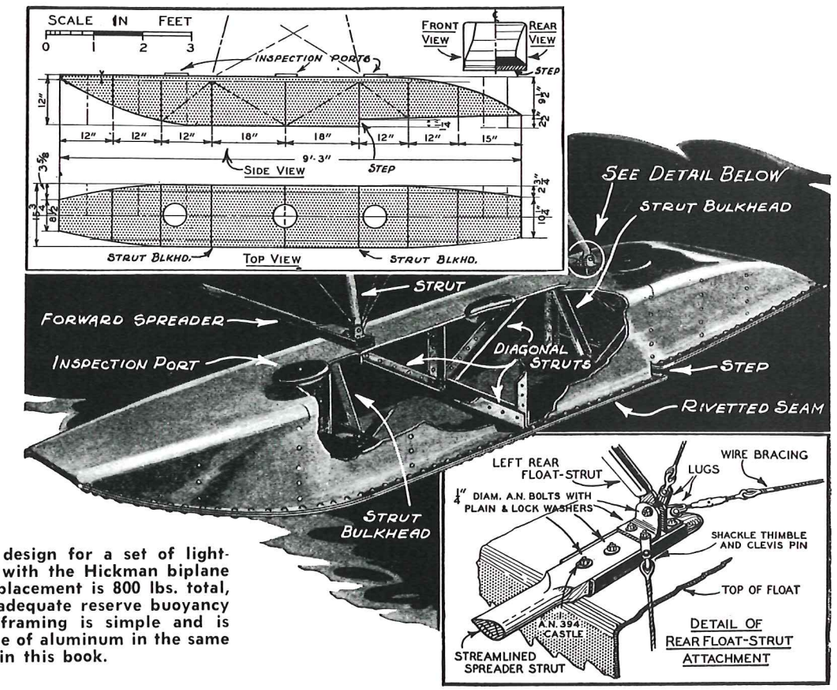
standard method. Put the wires on and be sure that your wings are square before you safety the turnbuckles. The top wing has no ailerons, but the bottom one has, so be sure and get this straight. Make your work neat and sand every part that you use until it is smooth. After the ship's wings are all put together, give the old wood a break and coat it with a nice coat of good varnish. Two coats are much better for this little ship, for it will be in the water all of the time.

Ailerons

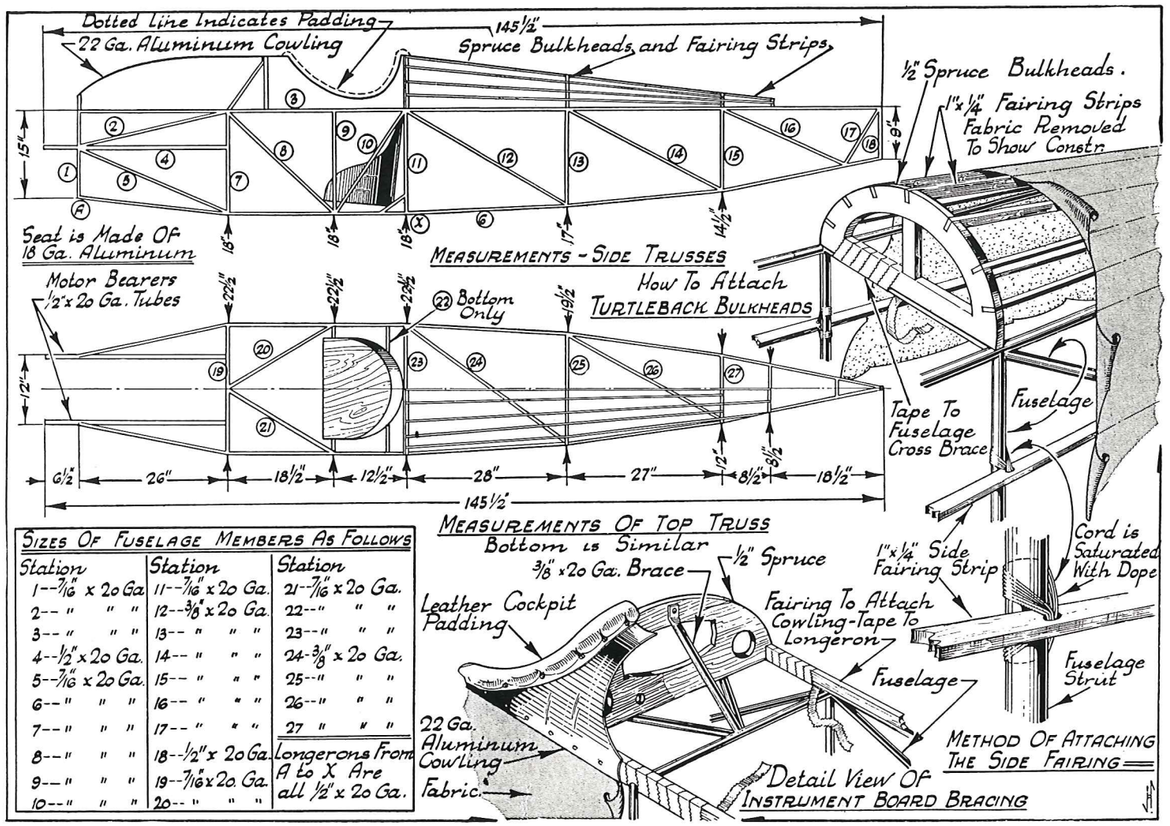
This feature of the ship is very simple. Just lay out the spar and use the ends of the ribs that you cut off from the wing to make place for the aileron. Space the ribs so they come right in line with the main ribs, glue and nail the parts in place. Secure the control horns carefully as this is important. Varnish and cover.

All of the different parts are made of steel and you lay out your different parts just like you did the fuselage and spot them together first, then weld them together afterwards. Put all of your fittings and hinges on here in this stage of construction, also coat this part of the ship with Lion Oil.





Simple and tried is this design for a set of light-plane pontoons which go with the Hickman biplane design. The combined displacement is 800 lbs. total, so they will have a very adequate reserve buoyancy for the little ship. The framing is simple and is shown here. They are made of aluminum in the same way described elsewhere in this book.



SIZES OF FUSELAGE MEMBERS AS FOLLOWS

Station	Station	Station
1--7/16" x 20 Ga.	11--7/16" x 20 Ga.	21--7/16" x 20 Ga.
2-- " " "	12--⅜" x 20 Ga.	22--" " "
3-- " " "	13-- " " "	23--" " "
4--½" x 20 Ga.	14-- " " "	24-⅜" x 20 Ga.
5--7/16 x 20 Ga.	15-- " " "	25--" " "
6--" " "	16-- " " "	26--" " "
7--" " "	17-- " " "	27 " " "
8--" " "	18--½" x 20 Ga.	Longerons From A to X Are all ½" x 20 Ga.
9--" " "	19--7/16" x 20 Ga.	
10--" " "	20-- " " "	

Built of 20 gauge tubing, there is nothing complicated about this fuselage to a man who knows his welding torch. Such a fuselage is necessary for marine use, as wood and wire is impossible to keep true, due to moisture variations.

outline of nails around the tubing to hold it in place. When all members are in place and double checked, it is time to spot weld the joints together. Just a word here about spot welding. This can be a very dangerous operation unless you know how to weld. If you don't know the ART of welding, leave it alone and get someone who does, for you will live longer. You make up the other side, then you are ready to place the fuselage upside down and rig to the plans for the top and bottom. Square up the fuselage with a square and plumb bob to the right dimensions. Be sure and get this operation right for the correctness of this operation means the success or failure of your project.

After the fuselage is all spot welded and trued up, then start at the front bay and weld around the station until you make a complete revolution of the fuselage, then go to the next station. That way you will run the warp right out the tail into space. The next thing to do is put the fittings on the ship for the tail group, pontoons, center section struts, etc. In fact, all parts that are welded to the fuselage structure. Then give the whole fuselage a coat of Lion Oil Paint. Fuselage is now ready to fair and cover.

Wings

The first thing to bear in mind in building wings for a ship is to use the best of spruce that you can find. Don't use any other kind of wood, also don't change the design, as you are not a designer; if you were you would not be using this design to build a ship. Follow the designs carefully and accurately, which will secure success in the end.

In building the ribs, the first consideration is the ribs. They are cut up from ¼ in. square stock and fit in rib jig and secured to place by 1/16 in. gusset plates and casing glue with ⅜ in. by 20 flat head nails, then taken out of the jig and the same procedure used on the opposite side of the rib.

Cut out your spars and bore them the right place, slip on the ribs and make up the drag struts. Cut out the drag wire fittings and bore them to fit the holes in the spar. The next thing to do is put the wing in as near rig as possible and get the correct length of wire, then make them up the

are 1/16 in., and run from the rudder bar back through fiber tube guides about 3 in. long which are securely taped to the fuselage struts, and to the rudder horns.

The fuselage fairing consists of two ⅝ in. by ⅝ in. spruce sticks which run from the top of station 4 to the two rear cabane struts, per dotted lines, and two long pieces, ¼ in. by ⅞ in. which run from the upper rear corners of the cockpit back along the center of the fuselage to station 6. They are held out by cross pieces of the same material which are taped to the vertical struts. The whole job should now be given a couple of coats of metallic paint. The running gear should be streamlined with cedar or balsa which is shaped and taped on and then enameled to suit your fancy. We used glossy black.

Skid Is Ford Leaf

Cover the fuselage by stitching and by tacking to nailing strips which have been taped to station 1. Tape and dope as before. The running gear may now be fastened on and the tail skid placed. The skid is a standard Ford spring leaf. The wings may now be fastened on. It is best to place a high horse under the tip of each wing, blocking them up until they set at the proper dihedral angle, about 1½ deg. You will note that the pylon is held by the main wing bolts. The pylon is best made of ⅝ in. by 18 ga. chrome-moly and should be streamlined.

HENDERSON LONGSTER SPECIFICATIONS

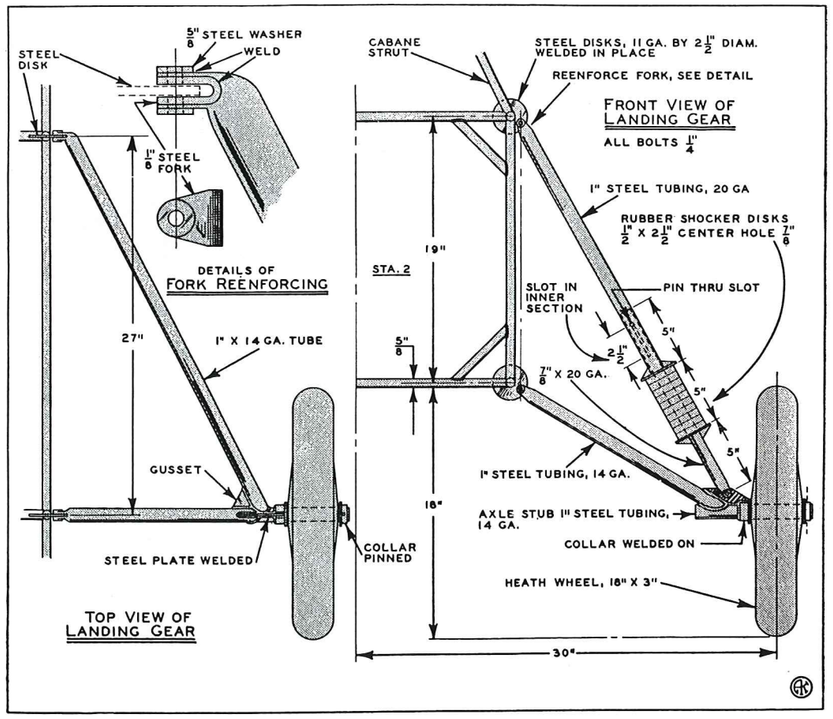
Span	30 ft.
Length	18 ft. 6 in.
Chord	4 ft. 2 in.
Dihedral	1½ deg.
High Speed	75 mph
Landing Speed	25 mph
Take-off Run	200 ft.
Weight Empty	325 lbs.
Weight Fully Loaded	575 lbs.

APPROXIMATE COST OF MATERIAL FOR HENDERSON LONGSTER

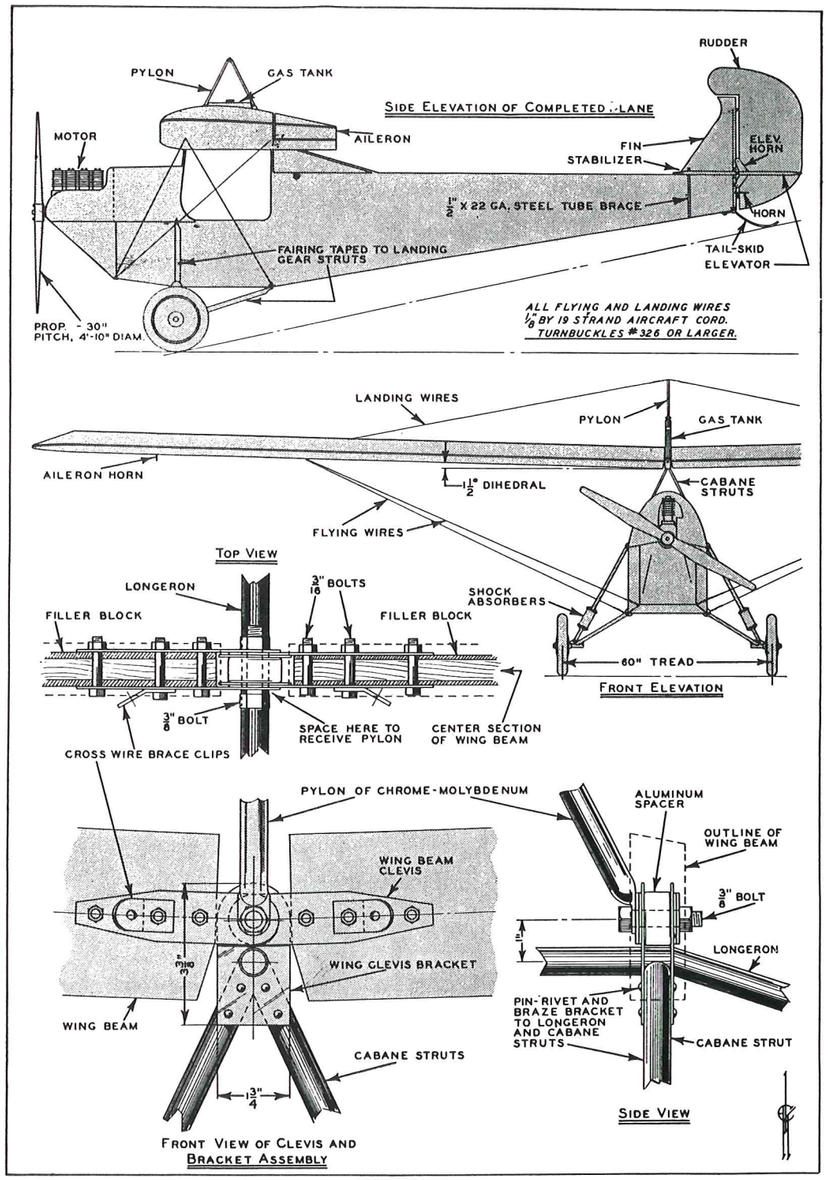
200 ft. Steel Tubing at 22c	$ 44.00
35 yds. Fabric at 20c	7.00
7 gal. Dope at $2.00	14.00
Varnish, Lacquer, etc.	3.00
Wheels and Tires	40.00
Wire, Turnbuckles, Bolts, Fittings	10.00
Miscellaneous	5.00
	$123.00

Power Plant $75.00 to $300.00

All the flying and landing wires are ⅛ in., 19-strand aircraft cord. The turnbuckles are No. 326 or larger. Cut the landing wires first, taking great care to get them the correct length. The turnbuckles are at the pylon end. The method of attaching the wires to the wing spars is original with us, so far as we know. It has the advantage of great simplicity and lightness. Eyes are made



Readers who remember the Driggs Dart, plans for which ran in the 1931 Flying Manual, will see the familiar spread strut above which was considered radical even as short a while ago as the Driggs. The rubber shock discs have little recoil and are better than shock cord. The axle stub must be very carefully welded.

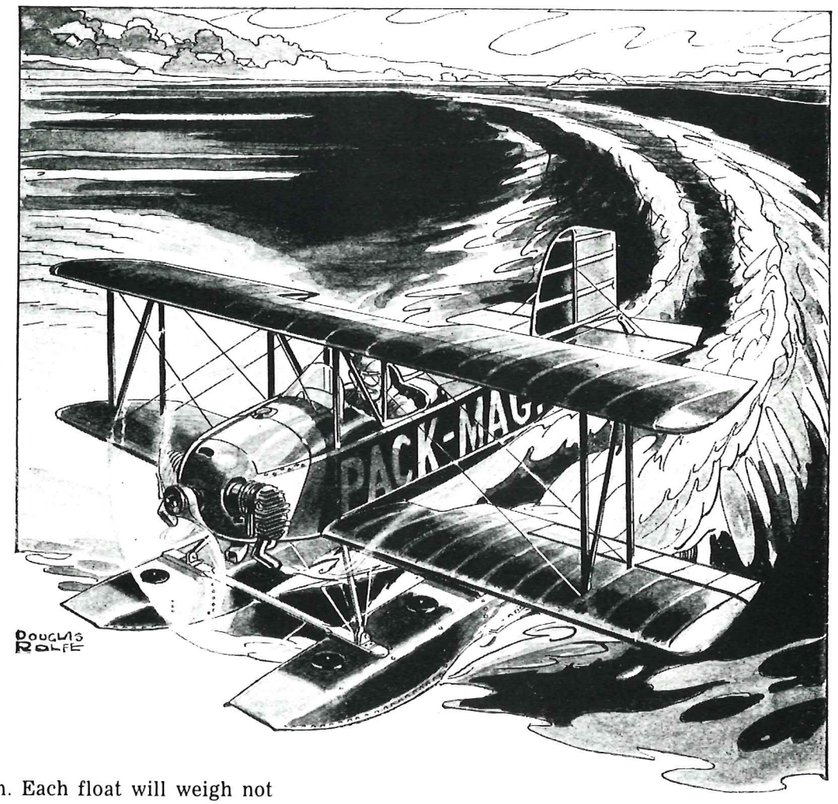


Here's the way the wings are "grafted" to the pylon clevis. There is 1½ deg. dihedral, rigged as shown. The 2-gallon gas tank sits in the pylon V and is enough fuel for two hours extended flying. Gravity feed is used.

in the ends of the cables, using regular thimbles for the purpose, and the bolts pass directly through these and the spar, with a washer next to the bolt head and nut. The upper bolt of the fitting takes only the landing wire. The lower bolt takes two flying wires, one on each side of the spar. The bolts are put in place through the little windows in the wing, which are then covered with pyralin attached with small brass screws. Place heavy canvas discs around the wires where you have pierced the fabric for them to enter the wing.

Place the tail group in position, using No. 14 hard wire and 324 turnbuckles where wire braced, and ½ in. by 22 ga. steel tube for the little diagonal struts. True the tail up square and neat, keeping the stabilizer chord parallel with the top longeron.

The power plant is the final task. No doubt you have made a preliminary fit on the engine and it should now be permanently bolted down, and



Here is Doug Rolfe's interpretation of the Pack Mag Seaplane just lifting off after a run down stream. The ship is powered with a Cross Country Twin. The floats are made of duralumin. The ship as a landplane has proved very successful, and the float units have worked well on another type plane.

of 16 ga. soft aluminum. Each float will weigh not over 12 lbs. apiece.

There is about 800 lbs. of buoyancy in the pair of floats, and as the general rule is 100 percent excess buoyancy, we have plenty.

The ship will be powered with a Henderson preferably, or with an Aeronca, Cross Country, Szekely or Irwin.

With these motors the loaded weight, less pilot, will be from 325 to 350 lbs. Allowing for a 165 lb. pilot the ship will fly at 60-80 miles and will land and take off at right around the 35 mile an hour mark. The climb will be about 300 feet per minute, which is comparable to the climb of the Heath with pontoons, or a loaded Air Camper without floats.

The take-off run will be about 500 ft., which is one-tenth mile. This is much less than the average seaplane run, and is accounted for by the low take-off speed.

The useful load will be 205 lbs. at these figures. Of course, there is no law against putting more in, but I think it best to fly with some reserve.

Normally, this ship will be strong enough for stunting, but don't forget that it is not best. It will be amply strong and then some to meet all flying conditions, and will get out of any jam you get it into, even if you have to power dive her to recover, but with floats an added couple is introduced in stunting that will tax the little bus. Don't loop her or that kind of thing. Such stuff is getting passe with good pilots nowadays, anyway. There's plenty of thrill just going up and flying without flirting with a broken neck.

The ship is good, it is simple, it is not new or radical, but merely a conservative, safe and sane little wagon that will amply repay those of you who want to build a ship you can fly with from water. You can use her to your heart's content if you have a fairly protected stretch of water, and she'll teach you plenty about airplanes.

Starting to Build

We'll start with the fuselage first, as this is the most important part of any airplane aside from the wings.

It must be accurate.

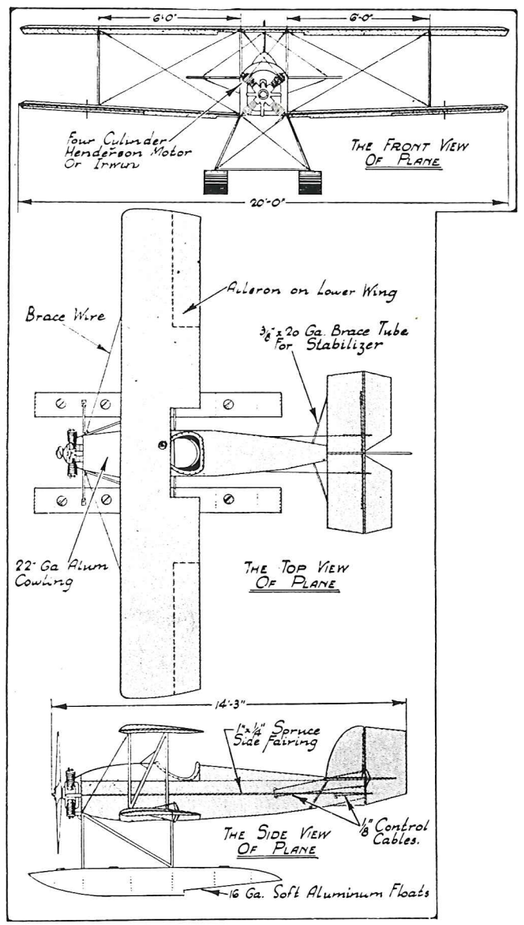
First add up the amount of tubing you'll need, allowing about 10 percent for waste in cutting angles, etc. There are two types of tubing used — you can use either 1025 or 1020. This can be secured from the Corben Aircraft Co., Madison, Wis.

You must have a flat surface to lay out the fuselage. The sides will be laid out first, putting all of the uprights and diagonals in their respective places. This operation can be done by putting an

PIETENPOL SEAPLANE FLOATS

by ORVILLE HICKMAN

In this biplane-seaplane, Hickman has taken time-tried essentials and assembled them into a long-looked-for design. A number of engines are available: Henderson, Irwin, Szekely and Aeronca, or the Packmag Cross Country. Speeds of from 60 to 80 mph can be had with this power range.



What ho! You lightplane fans for the last four years have been looking for a good, cheap and simple biplane, haven't you?

Well, here it is, and she is a honey.

And what is better — let us say an added attraction — she has been designed from the water up as a seaplane. There is added sail to take care of the little pontoons and enough soup in the motors specified to make it absolutely an assured fact that the ship will hop off and fly real well.

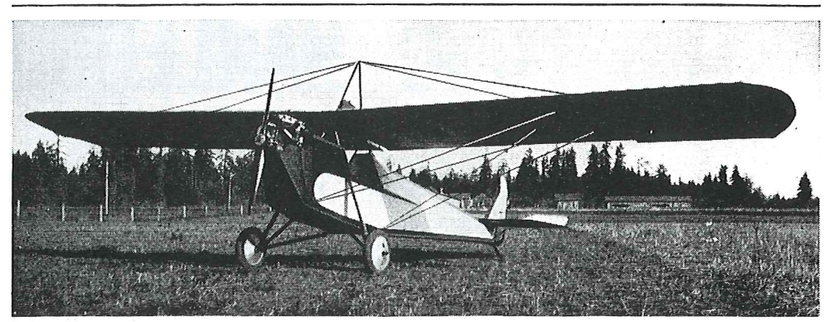
Design Is Tried

As a landplane it has been successfully built and flown. The ship is quite similar to the one I built from plans by another engineer, but out of experience I have injected some big plane practice in the thing, have run through a primary empirical stress analysis on it, and generally worked from the landplane point of departure so that this ship is as stout as a church with a safety factor of five, and with the new Aeromarine 2-A wings I have designed (same as Waco 9 and 10s use) she'll take off like a sore stomach.

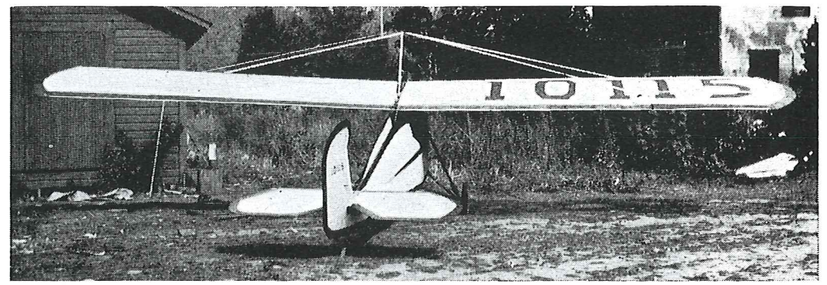
My landplane used I struts made of plywood, but I found this heavy. The Irwin and the Lincoln Sport used this I strut idea, and so did I, but give me the steel tube N strut. It is lighter and far easier to line up properly. You'd think that an I strut would line up easy as pie, but it won't. It is difficult to get the little fittings in the same line. The screw line-up as used on all big planes will allow you to eliminate any warp you may find, and is more satisfactory to build.

Performance

The floats are substantially Heath floats, and credit for the shape of them must go to that redoubtable little wizard of the air, Ed Heath, who first used them with his famous Parasols. I have used my own type of metal construction, however, and the hulls are of 26 ga. dural with angles made



The pilot puts one leg in the cockpit, runs himself across the longerons with head on other side, draws in the other foot, and there he is. Note the gas tank just over the center section leading edge, holding two gallons of gas.



Another view which shows the exceptionally clean little ship. One can gain an idea from this what slight drag there is. This is a requisite when light power, such as the Henderson is used. Henderson motors have often been very greatly over-rated as to power and require careful designing, but are reliable plants.

the bolts carefully cottered. The throttle, switch, tachometer, choke and oil pressure leads are brought back to the dash, which is of ¼ in. plywood. This dash is attached to the front sides of the cabane struts with aluminum clips, and is made with slightly rounding sides and rounded top. It should be finished in black or aluminum. The cowling is not as hard to make as on most jobs. While it is very hard to explain just what to do, a little experimenting with paper patterns will make it easy. A bulkhead of the same height as the dash, but narrower, is placed just back of the motor and fastened to the tubing with 20 ga. aluminum clips. The top cowling is simply a large sheet of 22 or 24 ga. aluminum bent down over the dash and bulkhead and is held to them with roundhead, nickeled screws. It is held along the sides by machine screws passing through aluminum clips around the longerons. The lower part of the cowling is another large sheet which is bent up from below. The rear edge is screwed to a nailing strip which has been taped to the lower member of station 1. The front corners are screwed to the motor bearers and the sides are screwed to the nailing strips at station 1. On the left side a piece is put on to form the air scoop as shown in the photos. This should be readily detachable.

As to the fuel tank you may use your own judgment. A cowl tank would be best, but we had trouble with the long intake manifold necessary, but hope to work this out later. The tank we use is a simple flat job that rests on the top longeron between the pylon struts. It is the thickness of the spacing between the wing butts, and holds 2 gal. It is light and simple and holds enough gas for 1½ hours flying. The gas line comes down from the rear end, passing along the side of the cockpit and to the carburetor. A shut-off valve should be placed in the line.

In building this ship your first thought must always be for safety. Every bolt must be cottered. Every joint a perfect one. Don't leave anything to chance. While the description is naturally only a general one it should enable anyone with some knowledge of lightplanes to make a real ship.

And this makes your ship, when finished and painted and doped to please you.

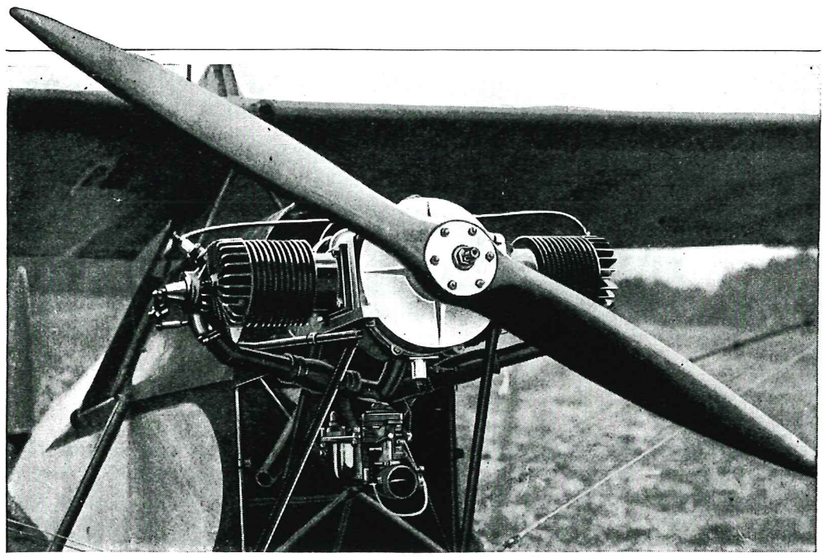
We have a surprise in store for you next month. I have developed an engine made out of Harley Davidson parts that is a honey, and no maybe. She can be built by anybody, and I can furnish crankcases. She is a twin opposed job, and yanks these little wagons into the air right now, without a long overland grind.

There is a magneto for ignition, carburetor, of course, and a lot of perfectly obvious junk on her but she is cheap, and flies with a roar, and cannot be killed. The heart of any motor, aside from the crankshaft, is its lungs and the Harley lung is a world beater — you know that.

So until next issue, it's adios, and we'll see you in a good game over the motor, eh? •••

THE LONG HARLEQUIN MOTOR

Weighing 90 pounds and delivering 30 horsepower, this powerful air-cooled motor, built up out of stock parts at a cost way below $100.00, is the answer to the lightplane builder's prayer for a thoroughly tested power plant. Harley Davidson cylinders are used.



As sweet a "baby" as ever turned a prop! The "Harlequin" sets neatly on its mount, and because of the balance and symmetry of its design, presents little difficulty in cowling to a perfect streamline. It has proved itself in service.

Ever since this flying game started amateur builders have been confronted with the problems of a power plant. Light engines have always been scarce and high priced. Right today there is a very limited choice for the man who isn't free from the worry of expense.

For some reason there have been very few good light airplane motors built. The famous Bristol "Cherub" has probably been the best in this class, but it, like the others, has been handicapped by the high price. For years determined efforts have been made to convert various automobile and motorcycle engines for use in flying. Some of these, notably the Ford and Henderson, have worked out fairly well, but they had serious limitations. At that, they have done a lot for the amateur game.

When we began building experimental lightplanes a few years ago we at once ran into this engine problem. The kind we wanted were too expensive and the kind we could afford were not what we wanted. So it was that while building our fourth light ship we decided to build an engine to go with it. From the start we were determined that the engine must have certain features to be practical. It must have only two cylinders. It must weigh under 100 lbs. It must be of the 4-cycle type, be free from vibration and overheating and must develop 30 hp or more. Finally, it must have both a low first cost and a low maintenance cost. It looked like quite a task, but it turned out differently.

The first problem was the cylinders. To have them made up was out of the question. It didn't take long to decide that our only chance was the 74 in. Harley cylinder. They are noted for long life and are low priced and available. The valves are large and the valve chamber allows the best cooling possible to obtain in any design.

With this settled, things went ahead rapidly. Crankcase and shaft were designed and made up. Rods, pistons, pump and all accessories were chosome may feel like using ordinary aircraft wire for rigging the wings, it is not desirable and should be avoided. Rig the ship with great care, as the wings must be true in every respect.

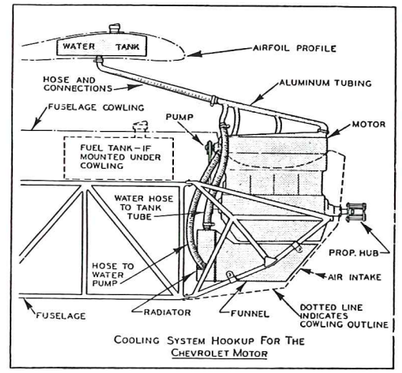
Covering

Use a good grade of airplane fabric throughout and give six coats of dope, using pigmented dope for the last three coats. Added attractiveness is obtained by finishing the ship in one of the many striking color combinations which Berry Brothers, Detroit, furnish on request for a nominal sum — if indeed they make any charge at all.

Miscellaneous Details

The motor cowling will naturally depend on the type of motor selected. However, if a Ford Szekely or Packmag Twin type is employed it will be necessary to check the weight and point of balance before making a motor mount to accommodate the engine. In any case, it will be advisable to check the point of balance *whatever motor is used,* before drilling the engine bearers and bolting the motor down. A good plan is to shift the motor back and forth along the bearers until the proper balance is obtained.

If a water cooled motor is used, a remote temperature gauge should be fitted and the motor always run up to about 150 deg. F. before attempting a take-off. A Paragon 10 J 60 in. propeller is satisfactory for the Chevrolet motor. For Ford motors, use the propeller recommended by Mr. Pietenpol and for other motors obtain the manufacturers' advice on the subject. •••

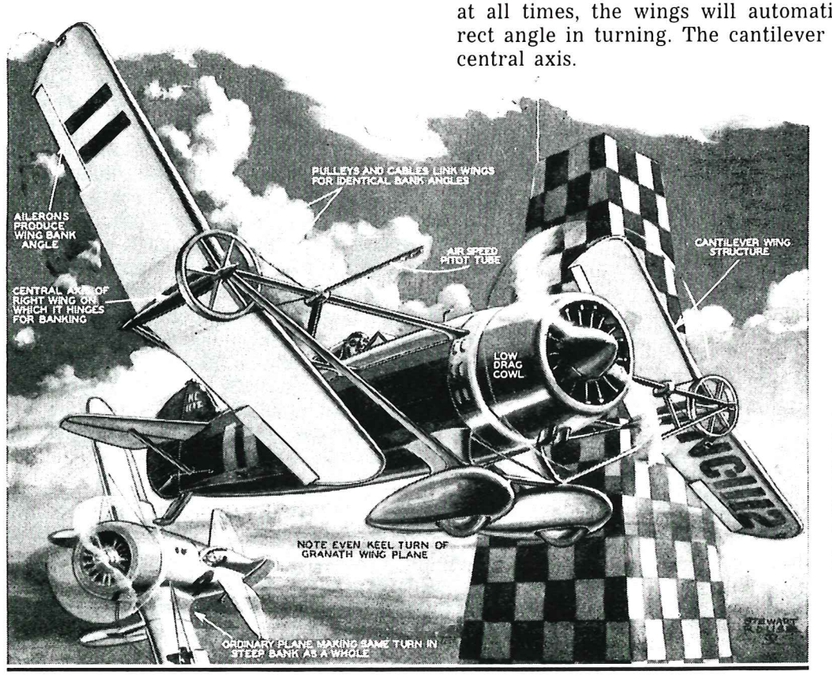


Chevrolet motor cooling hookup.

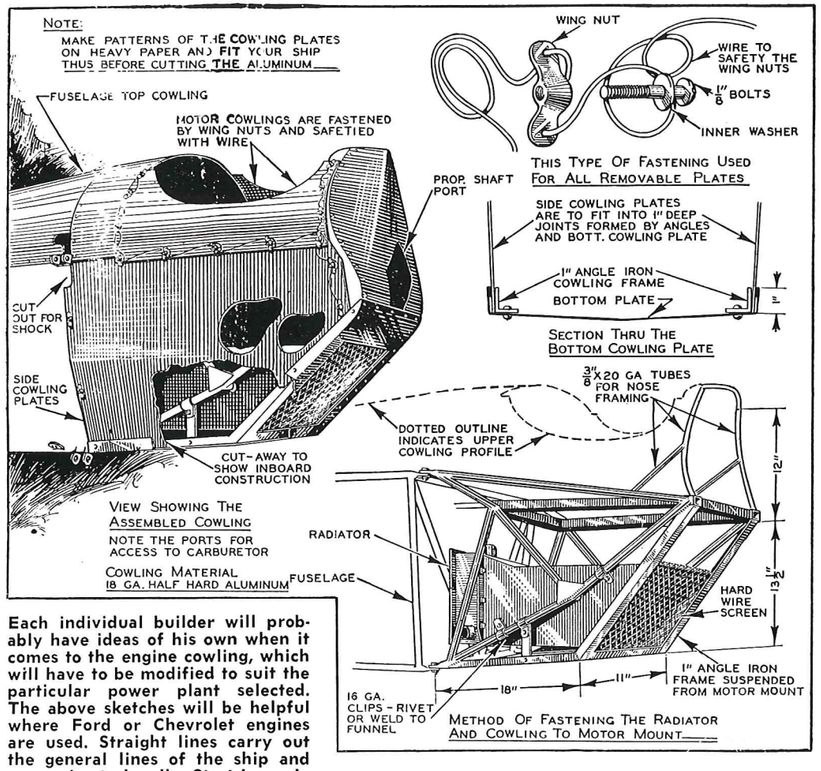
INVENTS NEW TYPE AIRPLANE WING

J. D. Granath of Chicago, inventor of the automatic variable pitch propeller and the Hi-Turb power head, is now working on a new type of airplane wing which must be taken seriously, since his success as an inventor is already firmly established.

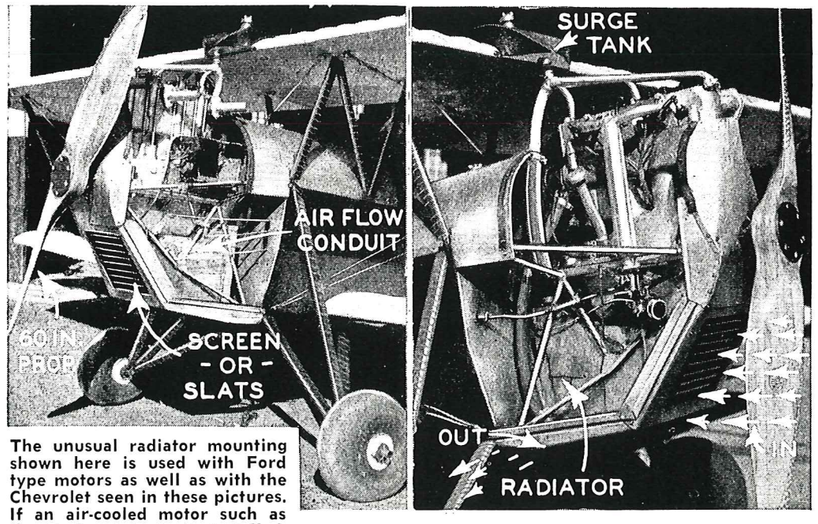
The drawing below shows a mid-wing plane equipped with this wing. Owing to the pull of gravity on the struts at all times, the wings will automatically bank to the correct angle in turning. The cantilever wings are hinged on a central axis.



How the Granath Wing plane will appear in flight. Centrifugal force and gravity will automatically keep the wings at the proper bank, although they may be banked at the pilot's will by the usual action of the stick and ailerons.



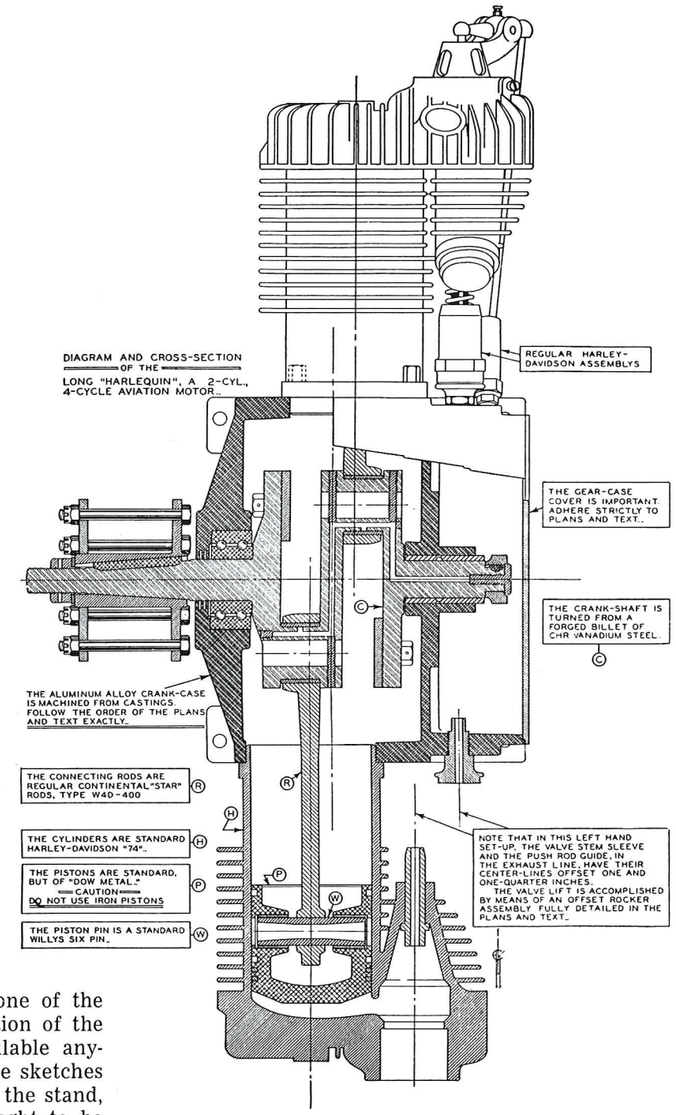
Each individual builder will probably have ideas of his own when it comes to the engine cowling, which will have to be modified to suit the particular power plant selected. The above sketches will be helpful where Ford or Chevrolet engines are used. Straight lines carry out the general lines of the ship and are easier to handle. Start by making paper patterns.



The unusual radiator mounting shown here is used with Ford type motors as well as with the Chevrolet seen in these pictures. If an air-cooled motor such as the Packmag Twin is installed, the radiator is, of course, eliminated.

PLANS

This diagrammatic semi-cross-sectional view of the "Harlequin" shows to advantage the simplicity of its design. The adoption of a number of standard parts in its assembly is an item to be considered quite seriously in contemplating the cost of its upkeep. All of the parts used may be obtained at prices that are not prohibitive to the amateur, and almost any parts outfit can be your supply house. The compact arrangements of the different assemblies, and the uniformity of the whole design, together with its exceptionally light weight and low first cost make the "Harlequin" approach very nearly the ideal in small power plants. While the two-throw crankshaft using straight line con rods necessitates offsetting the cylinder centers, a very clever arrangement is incorporated in the plan of this motor to eliminate effectively the difficulties usually found in accomplishing a proper valve action through the offset. A set of offset rocker arms is built up to transmit the lifting action from the push rod to the valve stem, thus doing away with any form of bent or curved members in this set-up. This item is a distinct feature of this particular motor. From the shaft gear to the piston pin, the entire line of parts is standard Harley-Davidson. The shaft gear, cam gears, cam stud plates, push rods, valve assemblies, push rod guides, valve guides, cylinders, and Dow metal pistons all are selected from this cycle line. Note the method of preparing the star rods to preserve the straight line thrust from piston pin to crank pin. Another feature to add to the "Harlequin's" list of novelties is the counterbalanced crankshaft with its drilled oil line. Total weight of the motor is only 90 lbs., which figures out at the rate of 3 lbs. per hp, the Harlequin developing 30 hp at 2650 rpm.



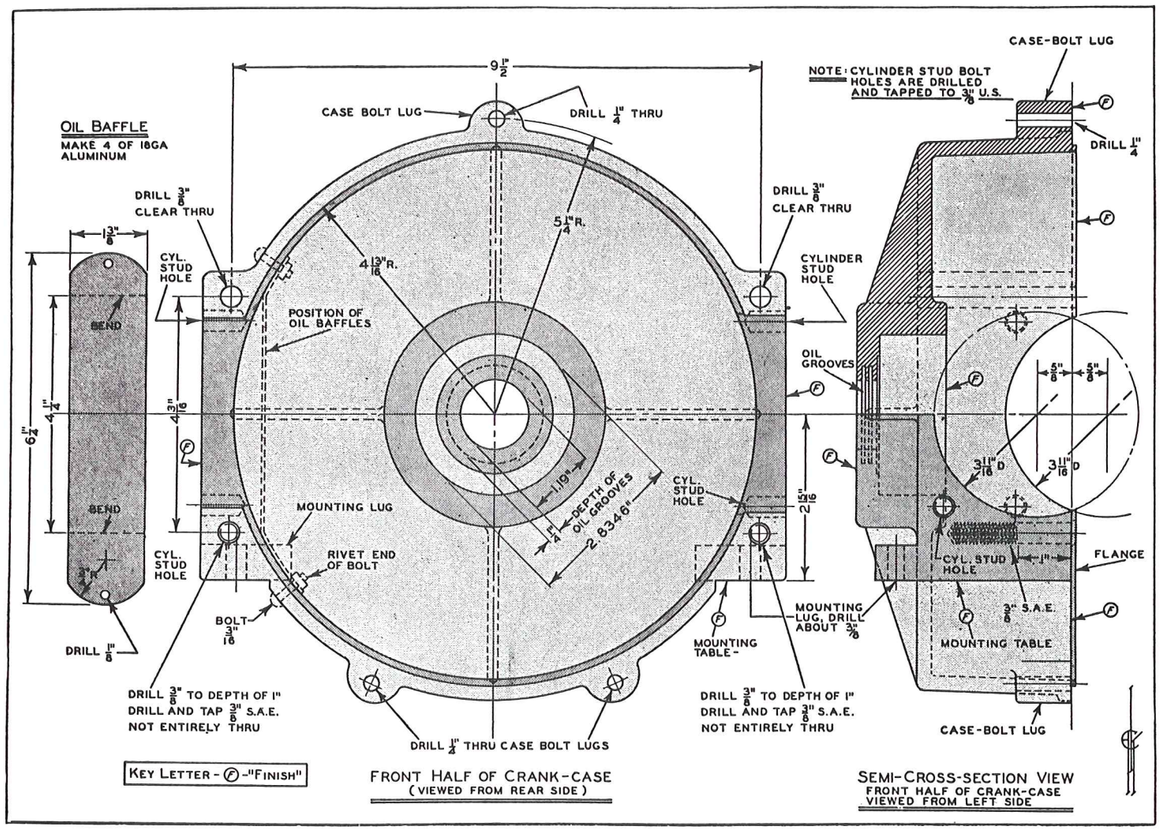
en from standard stock parts. This is one of the features of the engine. With the exception of the case and shaft every part in it is available anywhere in the world. Four weeks after the sketches were started the engine was running on the stand, and a week later it was flying. This ought to be some kind of a record.

Slight changes were made as the next three motors were built; since then not a change has been made. It is as near perfection as we believe it can be. It doesn't miss, vibrate, heat nor smoke. It starts easily and we have never had a fouled plug since we started, nine months ago. There has never been a single breakage nor noticeable sign of wear. Best of all, it swings a 5 ft. 2 in. prop for hours at 2,750 without faltering. What more could you want?

The bore is practically 3½ in. and the stroke is 4¼, giving a capacity of 82 cu. in. This figures 30 hp at 2,650 and it has all of that. The compression ratio is 5.3 to 1. The weight is 90 lbs. The mounting arrangement is the simplest possible. It sits on a bed rail cast on the crankcase and is held by just four bolts. The mount required is almost identical with that used by the Henderson, only slight changes being necessary to mount this on a Henderson mount. This does away with the weight and weakness of a ring mount.

The gas consumption is between 2 and 2½ gph and the oil used is really too small to measure. Because it has no clumsy built-in oil tank, and the carburetor bracket set back a few inches, the engine cowls in to a perfect streamline shape. There is nothing exposed but the cylinders.

The front half of the case is a simple job. It is held in the lathe by chucking the main bearing



This draft of the front section of the crankcase needs little explanation. With the castings at hand, instructions may be easily understood and followed, with no difficulty. A feature of this design is the set of baffle plates which eliminate the necessity of oil rings on the pistons. Detailed instructions for their installation will be found in following plans. The plans for this motor are so completely done up and elaborately illustrated that it has to be published at length.

boss in the jaw chuck. It is best to put thin strips of lead or copper in the chuck jaws to keep from marring the casting. After it is squared and centered, face off and cut the oil seal rabbet at the same time to the dimensions shown. Try to get a very neat fit on the offset. After this is done, carefully cut the front main bearing seat. The size given is the standard dimension of the bearing used. It is best to get this bearing first and mike it. The seat should be at least .002 undersize. The little grooves for oil are also cut at this time.

While doing the turning be sure that you get the measurements right. When the two halves are put together there should be a distance of exactly 4-9/32 in. between the face of the rear bearing boss and the face of the ball race. This leaves 1/32 in. end play for the shaft. The front half should be dipped in boiling water to put in or remove the ball bearing. This bearing is an SKF, No. 5306. It may be had at any supply store.

At this stage the next major operation will be the crankshaft. As stated, it is unusual to expect the ordinary shop workman to do this, but with the instructions it can be done easily and at low cost. The cost is very low, but it takes considerable time to do a perfect job. Go to any good forging shop and ask them to forge out a billet of 6140 chrome-vanadium steel to the size given. Tell them what it is for and ask them to make it flat and true. After it is forged it is to be normalized to a tensile strength of from 110,000 to 120,000 lbs. per sq. in. This billet will cost about $5.00.

After you have it, carefully mark, drill and saw it as shown. The three centers at each end must be kept perfectly parallel with each other, using a straight edge along their centers and sighting. After roughing out to the shape shown, center up in the lathe, using an outside pair of centers for each throw. Turn with a lathe dog. The throws, or crankpins, are finished completely at this time. Turn down to approximately 1½ in. dia-

additional layout referred to.

The center section strut attachment system is shown in the drawings.

Ailerons

Ailerons are employed on the lower wings only. They are built up in the same manner as the wings and are attached by three hinges which are shown in detail on the drawings. The aileron control is operated by torque rod and bell and crank. This control, also shown in detail, should be made and fitted before attempting to cover the ailerons and wings. The entire framework of ailerons and wings should be given a good husky coat of varnish before covering, and if you have any misgivings about the covering operation itself drag out the old 1932 Flying Manual again — it tells all about it there!

Tail Assembly

The entire tail assembly is so thoroughly explained in the detailed drawings that little comment is necessary. As it is a welded job from start to finish the same care should be lavished on this unit as has been already given to the fuselage. Make the necessary hinges for flippers and vertical rudder and all other fittings shown in the detail. After the assembly is completed check for fit on the fuselage, as it may be necessary to make a few alterations and this is more easily attended to while the framework is still uncovered.

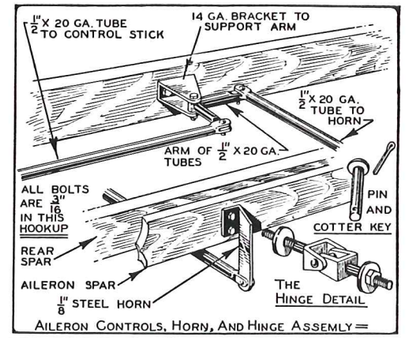
The Controls

These have been covered in great detail in the working drawings. One of the outstanding features of the Gere plane as Bud built it is the excellent operation of all the controls. As will be seen from the drawings, positive control is used in all cases with the exception of the rudder control, which is operated by cables. The location of the control column and rudder bar is not arbitrary — these units may be placed in what seems to be the most comfortable position for the pilot. This being the case, control rod lengths and similar measurements will have to be determined by the builder to suit his needs.

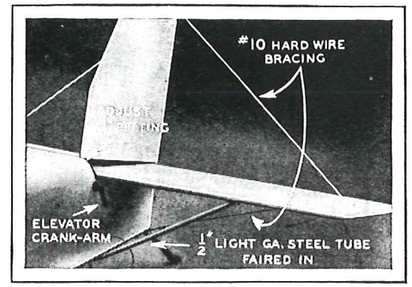
Instruments

The only essential instruments are the oil gauge, tachometer, altimeter, air speed indicator and switch. For those who have the means the combination instrument panel as used by Gere will add a finishing touch to this smart little ship, but it can of course be dispensed with.

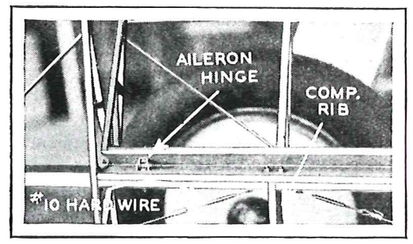
Wing struts are covered in detail drawings. The diagonal strut should be cut to the proper length before welding and a jig should be used in assembling both the outer bay struts and the center section struts. The center section struts are welded to the spar fitting at the top, but we recommend a moving joint at the fuselage point of attachment. This is not *necessary* and if the builder prefers he may dispense with fuselage fittings and moving strut ends at this point, merely welding the lower ends of the struts direct to the fuselage. Flying wires and wing bracing generally may be either ¼ in. streamline cable or stranded cable. Although



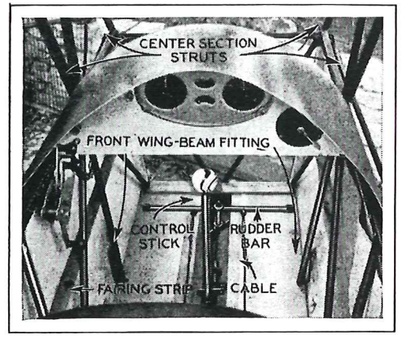
This detail drawing explains the aileron hinge construction and gives further information on the aileron controls.



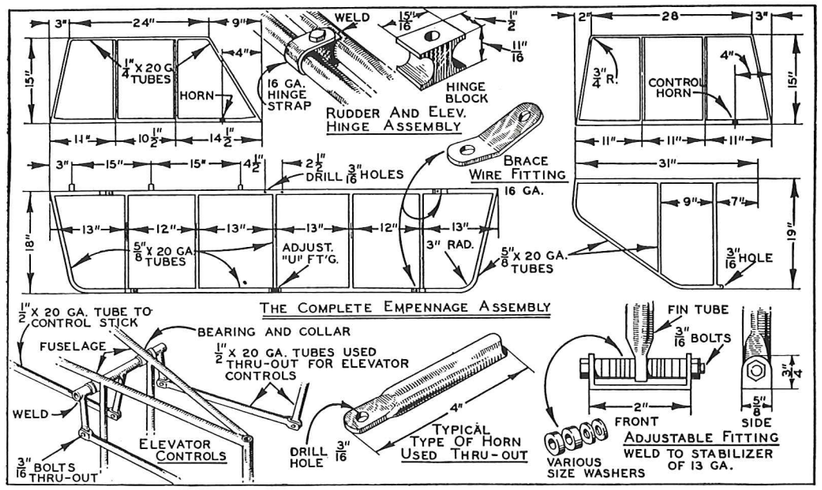
Tail group with elevators and horizontal rudder removed.



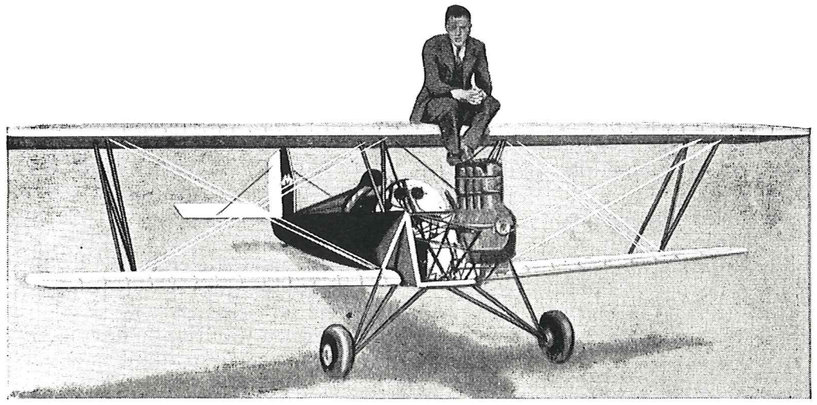
Closeup view of the aileron. The inboard aileron hinge and a compression rib are seen to advantage in this picture.



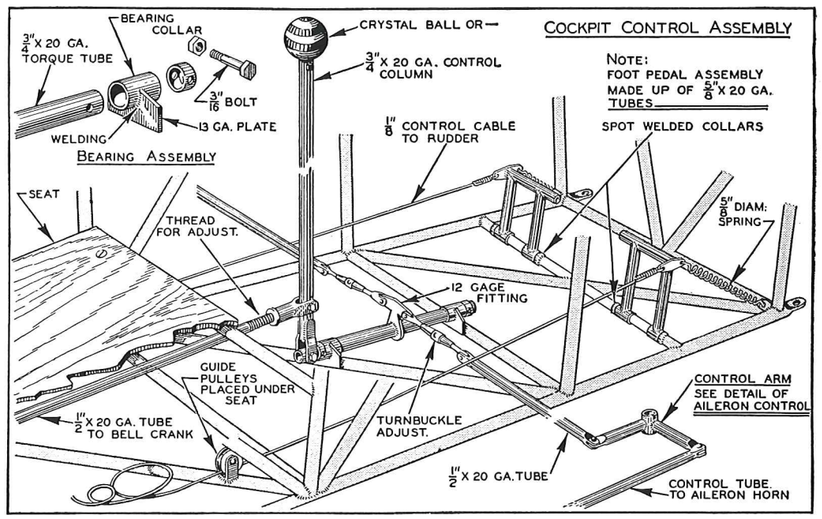
Close-up view of the partly finished cockpit with instruments on panel.



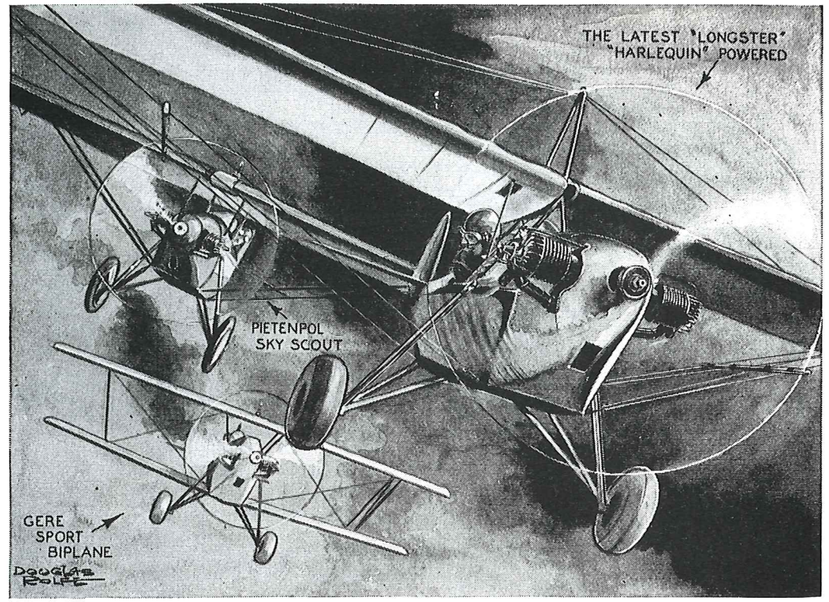
Extreme simplicity of the Gere tail unit makes these plans self-explanatory.



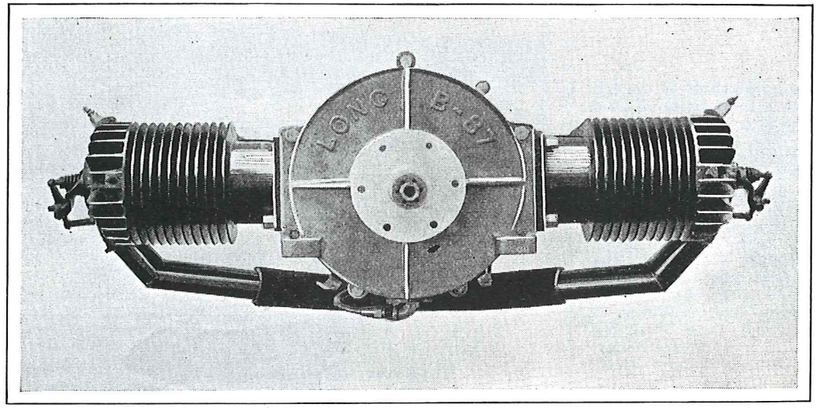
The late Bud Gere surveying his handiwork. This photo emphasizes the all-around sturdy construction of the ship.



Note that the vertical rudder is the only cable operated control.



Here's how the "Harlequin" hauls high on three of the lightplanes whose plans have previously been published in Modern Mechanix and Inventions! The Pietenpol, Gere and the latest Longster trail toot sweet behind this tiny Tornado.



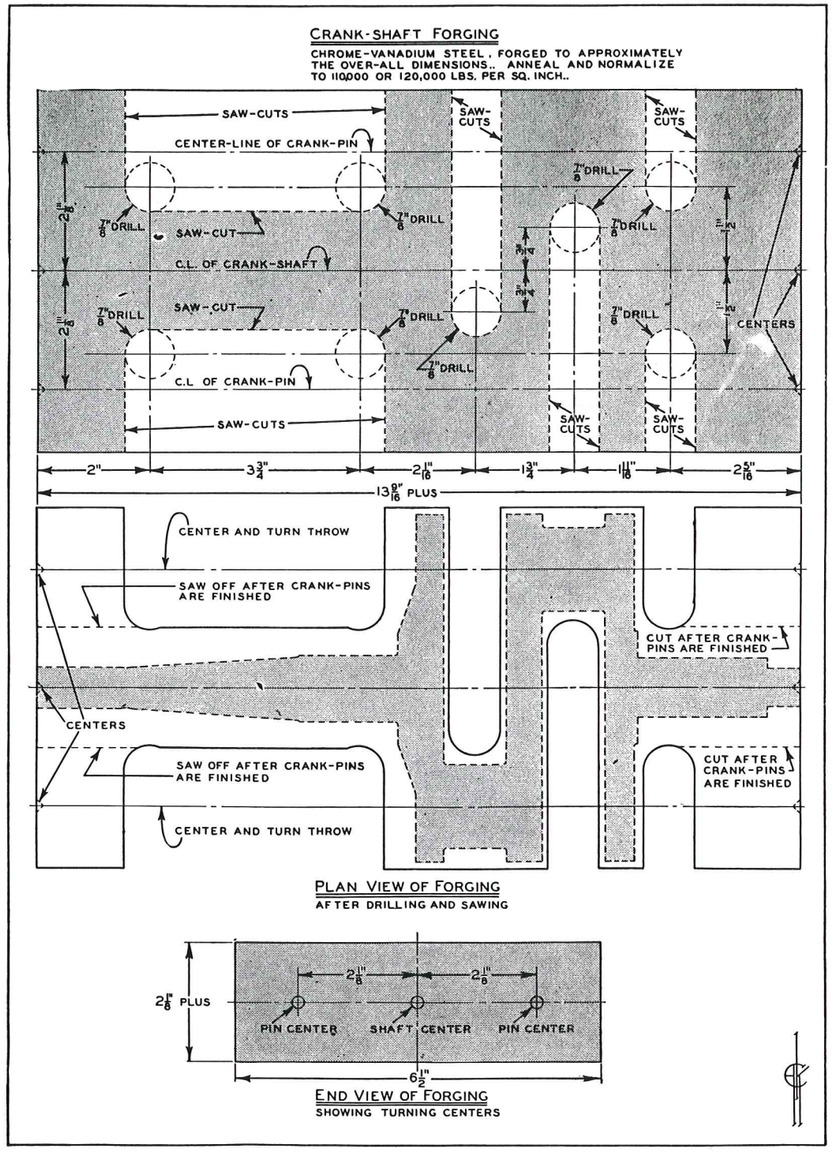
A nifty shot of the "Harlequin" showing off the front half of the cast aluminum crankcase to a sweet advantage.

meter and put on a high polish with crocus cloth. After these are done the ends are to be sawed off as shown by the dotted lines, and the shaft centered on its true centers and completely finished.

The diameter shown at the front end for the bearing is the standard inside diameter of the 5306 bearing, but it is best to keep the bearing handy and polish the shaft until the bearing can be just pressed on by hand. The rear part is polished to a perfect fit for the bronze bushing in the rear case. The hub taper is the standard taper used in the model T Ford wheel hub. Keep one of these hubs handy and carefully work the taper down until it fits as shown. This hub is now taken and turned to the dimensions shown and becomes the propeller hub. If you have a milling cutter you can cut the key seats, or you can have it done elsewhere. The large one is the standard Ford and the small one at the rear is for the regular Woodruff used in the Harley.

Thread the front end for the hub nut. Tap the rear end for the gear retaining screw. The oil lines require a little care in drilling to keep them straight. After drilling, plug as shown with brass or iron screws. Be sure to blow all shavings out of the oil line. The counter balances are milled or filed from a piece of mild 1025 steel. Make them weigh all alike, approximately 14 ounces each. Bolt them on securely. It is best not to drill the hole in the side of the rear shaft until the oil line has been put in the main case, so they will check.

This shaft is a thing of beauty and you will be proud of it. It takes more time than any other part

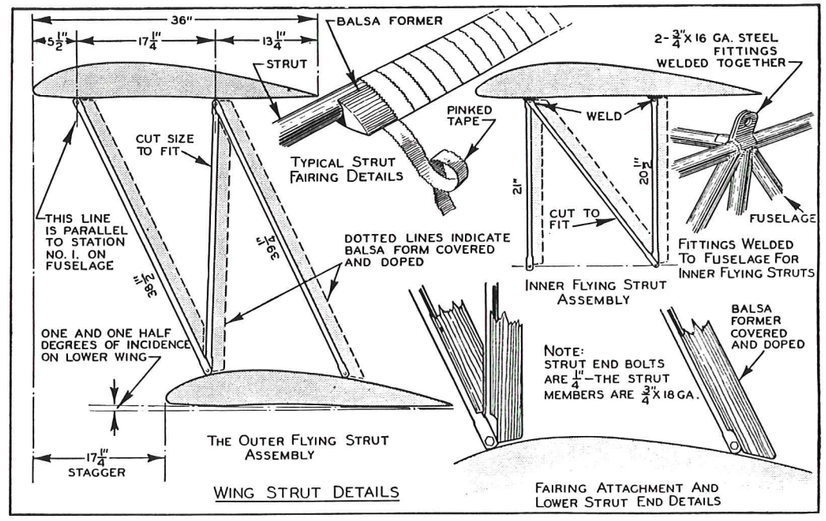


The crankshaft is turned from a solid billet of steel forged to the formula given. The various steps in preparing and centering the forging for the lathe are quite plainly shown in the draft above. Lay out the drillings and the saw cuts with care to allow sufficient finish for the turning. The rough billet should cost about $5.00. Making the crankshaft is the most time-consuming job of the entire motor, but with complete directions given it is not beyond the average craftsman's ability.

of the job, but is worth it. You will learn more doing this than you would in several weeks in a trade school. Use patience and watch your step and you will come out all right. Here it is almost necessary to have the full sized prints which are available from M-M's Blueprint Department.

Let us say right here that this engine can be built by any ordinary mechanic. It requires no special tools. All that is needed is a 16 in. lathe and drill press. No shapers, planers or special tools are required. Some wrenches, reamers, files, etc., are, of course, necessary. We are going to do an unusual thing by describing fully how to make the two-throw crankshaft. This means a saving of at least $50.00. Very complete detailed instructions will be given for every piece in it so that there will be no question of success. As to the cost, if one has a 23-27 Harley 74 engine the total cost of material will be under $50.00. You can't beat that.

To come back to the rear half of the crankcase. To attempt making the patterns and getting the castings made would be entirely out of the question for the homebuilder, but we have ar-



The moving end joints for the center section, or cabane struts.

aileron hinge bolts and cut the fuselage end of all the lower spars to an angle of 10 deg. This angle is necessary in order to secure a snug fit in the wing fittings attached to the fuselage on account of the dihedral angle of the lower wing.

The wings may now be assembled. Slip the ribs in place, following the plans for position, and secure in place. Bolt the drag fittings in place and rig the wing with No. 10 aircraft wire, using 325 SF turnbuckles to tighten. Great care should be taken in rigging the wings to insure that they are finished absolutely true.

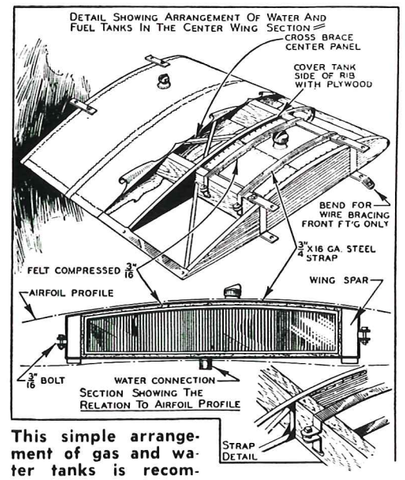
False ribs extending from the top of the front spar to the leading edge of the wing and situated between the main ribs are advisable. They are not shown in the drawings but can quickly and easily be made by taking lengths of 20 ga. hard wire and shaping it to the contour of the nose ribs. The ends of these wire nose ribs are pressed firmly into holes drilled in the front spar and the leading edge. If a more powerful motor is considered it will be advisable to cover the entire leading edge of the wings from the front wing spar to the leading edge member with 1/32 in. plywood. This in addition to the false ribs already mentioned.

The Center Section

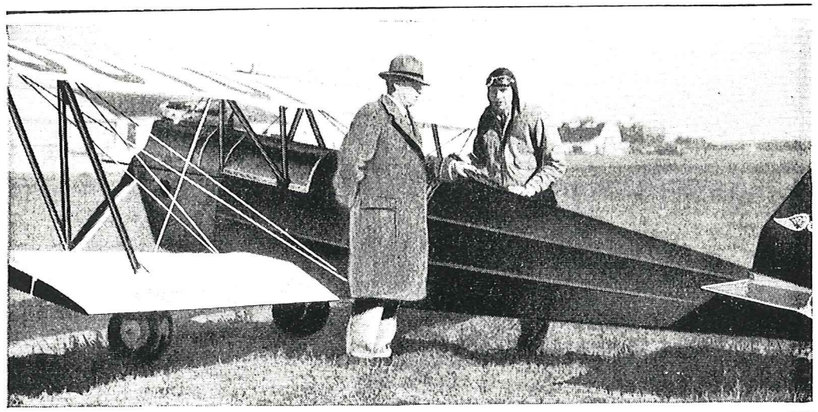
The center section is the next point of attention. Spars and ribs for this are exactly similar to the main wing construction, with the added suggestion that all four ribs be stiffened in the manner prescribed for the compression ribs. The spars should be drilled to take care of the upper wing fittings before assembling.

On the original ship no provision is made to carry either surge (water) or gas tanks in this member. It was decided later to incorporate one or *both* of these tanks into the center section *and our recommendation is that actually both tanks should be located here*. It will simplify things generally and in consequence of this decision a layout showing this form of installment has been added since the first plans were made — this layout will be found on the continuation pages.

It shows the disposition of the two tanks and you will see that this arrangement makes a slight change in the rigging essential. The tanks occupy the spaces between the ribs left and right, the center space being rigged with No. 10 aircraft wire the same as the wings. So before drilling the center section spars it will be necessary to check with the



This simple arrangement of gas and water tanks is recommended as most practical.



This picture was snapped at Wold-Chamberlain airport just after the plane had won her wings in a successful test flight. George Gere, Sr. is seen congratulating pilot Elmore Wall on his expert handling of the plane designed and built by his son.

to meet the form of the rib, this operation naturally being delayed until after the ribs have been made. While making the wing spars it would be a good plan to make the center section spars, one front and one rear, following the drawings for length.

Wing Ribs

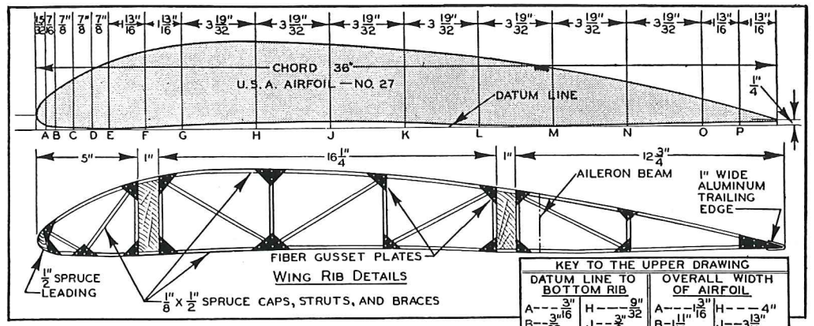
Each of the two upper wings requires nine full ribs, the two lower wings will each account for another four full ribs and five shorter ribs which extend to the rear spar only. In addition to these four more full ribs will be needed to complete the center section, making a total of 30 full ribs and 10 short ribs to be made before the wings and center section can be assembled.

The ribs are made from ⅛ in. by ½ in. spruce with gusset plates of 1/32 in. fiber. This latter material is obtainable from most electric supply houses and is recommended in preference to plywood, which, though permissible, is more difficult to handle.

After laying out the rib jig from the drawings, steam the cap strips until they are pliable enough to be bent; then place them in the jig. Next cut the truss strips to size and set in place, brush plenty of waterproof glue into each joint and nail the gussets on, taking care to use plenty of glue on each gusset before setting it in place.

Twelve compression ribs — three to each wing — are specified in the plans. These are illustrated in detail on the wing drawing. They are made by stiffening the ordinary ribs at the points specified. It would be a good plan to make all four ribs for the center section in this manner. The slight increase of weight is nothing in comparison to the extra stiffness which will result from this treatment.

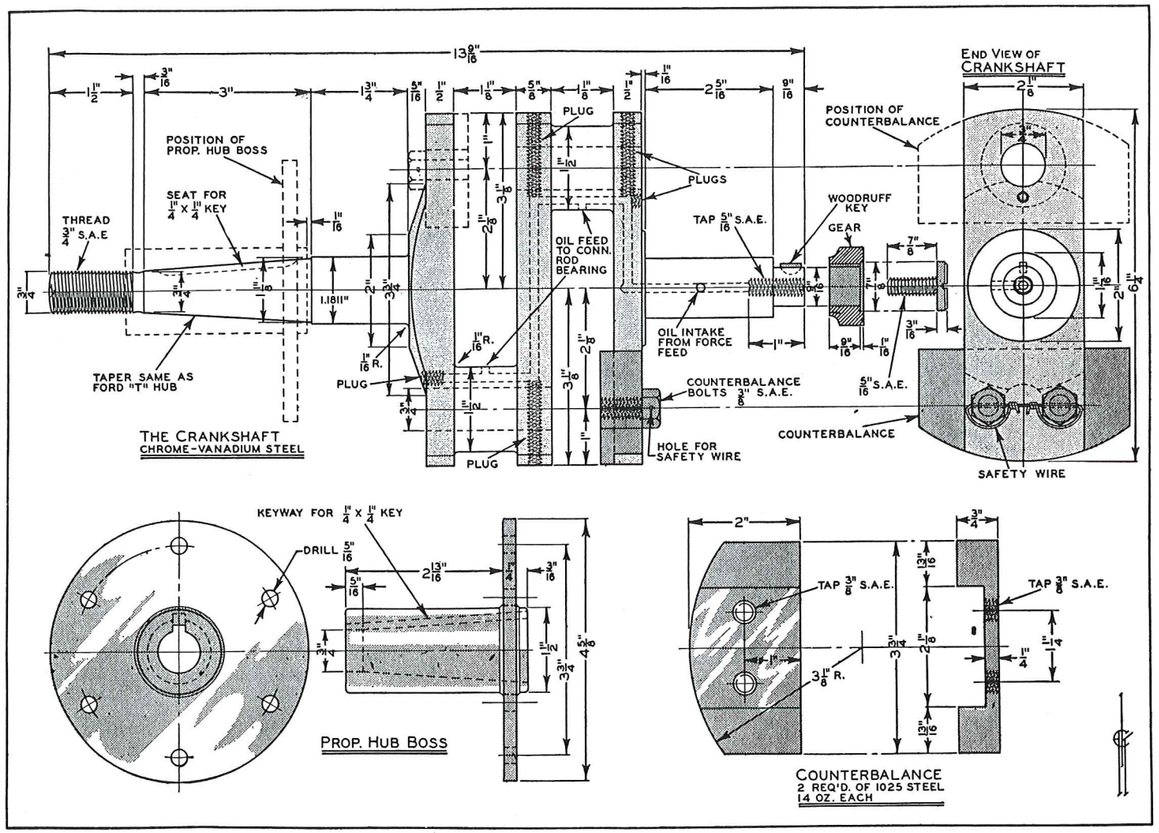
When all the ribs have been completed and the spars shaped to accommodate them the wings are almost ready to assemble. First, however, the spars have to be drilled for drag fittings, interplane strut fittings, etc., and the fittings themselves made. Follow the plans for these units. Drill the rear spar of each lower wing to accommodate the



KEY TO THE UPPER DRAWING

DATUM LINE TO BOTTOM RIB		OVERALL WIDTH OF AIRFOIL	
A — 3/16"	H — 9/32"	A — 3 1/16"	H — 4"
B — 3/32"	J — 3/8"	B — 1 11/16"	J — 3 13/16"
C — 11/16"	K — 7/32"	C — 2 3/8"	K — 3 23/32"
D — 1/64"	L — 3/32"	D — 2 29/32"	L — 3 5/16"
E — 0	M — 0	E — 3 5/16"	M — 2 7/8"
F — 11/64"	N — 0	F — 3 1/4"	N — 3 1/16"
G — 1/8"	O — 1/32"	G — 3 3/32"	O — 1 1/4"
	P — 11/16"		

The Gere rib is very strong and follows modern construction practice. Compression ribs are formed by covering ordinary ribs on each side with 3/32 in. plywood. Use this drawing in laying out a rib jig.



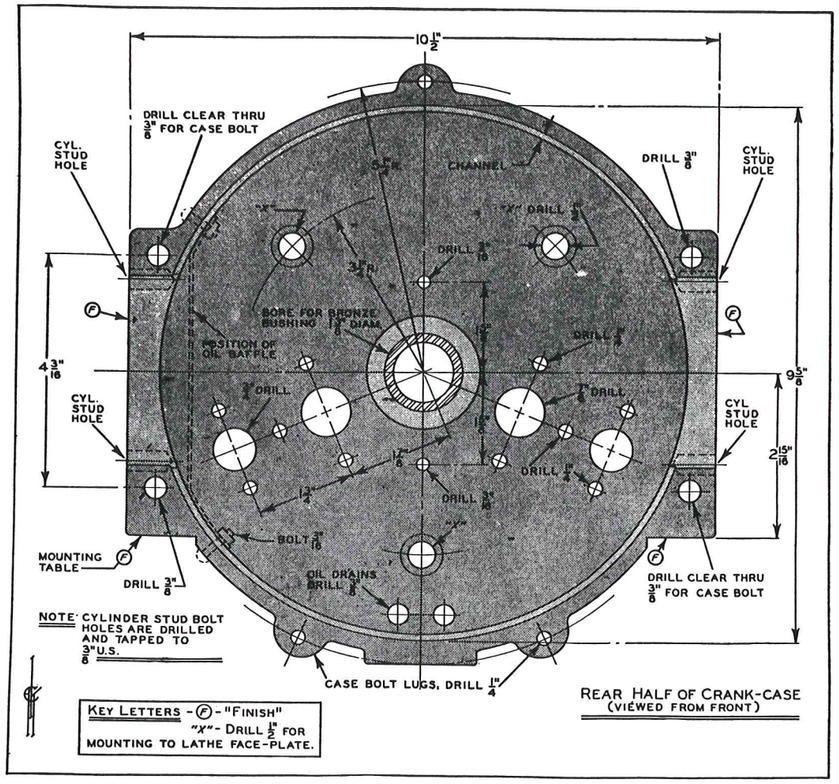
Turning the crankshaft on a 16 in. lathe requires a bit of time and effort, but is not actually as difficult as it may seem. No dimensions are given for the oil intake from force feed, as this operation must be taken care of in the order outlined in the text. Do not drill this intake channel until the test so indicates. When you have completed this crankshaft, a thing of beauty if there ever was one, you will have learned as much about machining as several weeks in a trade school could teach you. Follow the drawings and instructions patiently and you will complete the job successfully.

ranged to supply the complete set, including the rear cover, of 17ST Dural, for $18.00, crated. This would be half the cost of the patterns alone. The castings are finest aluminum alloy and can be supplied on an hour's notice. Editor's Note: All correspondence regarding castings should be addressed directly to Les Long, Cornelius, Oreg.

With the castings at hand they can be fully machined in half a day. Start on the rear half. Looking at the drawing you will notice three holes marked X. Drill these ½ in. and, using long bolts, bolt the case to the face plate with the gear case end against the plate. Shim up until the casting is all square and centered. Take a light cut off the face where the two halves will later come together. We will call this the center line. After taking this light cut turn the case around and fully finish up the gear case end to the dimensions shown. The case is again turned around and the center line end finished. The exact dimensions of the oil-seal rabbet are not critical. With a boring bar cut a 1⅜ in. hole through the rear bearing boss.

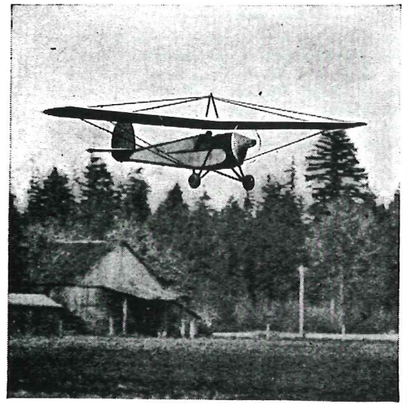
The rear bearing might as well be fitted now. From a piece of bearing bronze turn up a piece as shown, leaving it .002 larger than the hole. It should have a 1 in. hole through the center. Heat the case slightly with a torch and with the tail stock force the bronze in place. Carefully enlarge the center hole to 1-1/16 in. That does the rear half at present.

Place the two halves together, lining up the cylinder flats and the bolt bosses. Hold them that way and drill ¼ in. holes through the three short bolt bosses. Put bolts through and tighten. The case is now ready for finishing. This is done as shown in the two sketches. Lines running parallel with the shaft are scribed on each side of the case. Be sure these are exactly opposite each other, and exactly parallel with each other and the shaft line. On these lines measure ⅝ in. out from

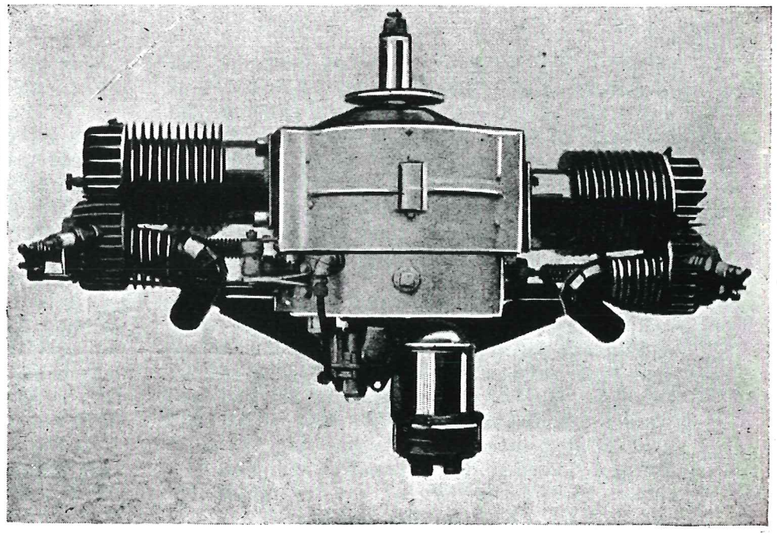


REAR HALF OF CRANK-CASE
(VIEWED FROM FRONT)

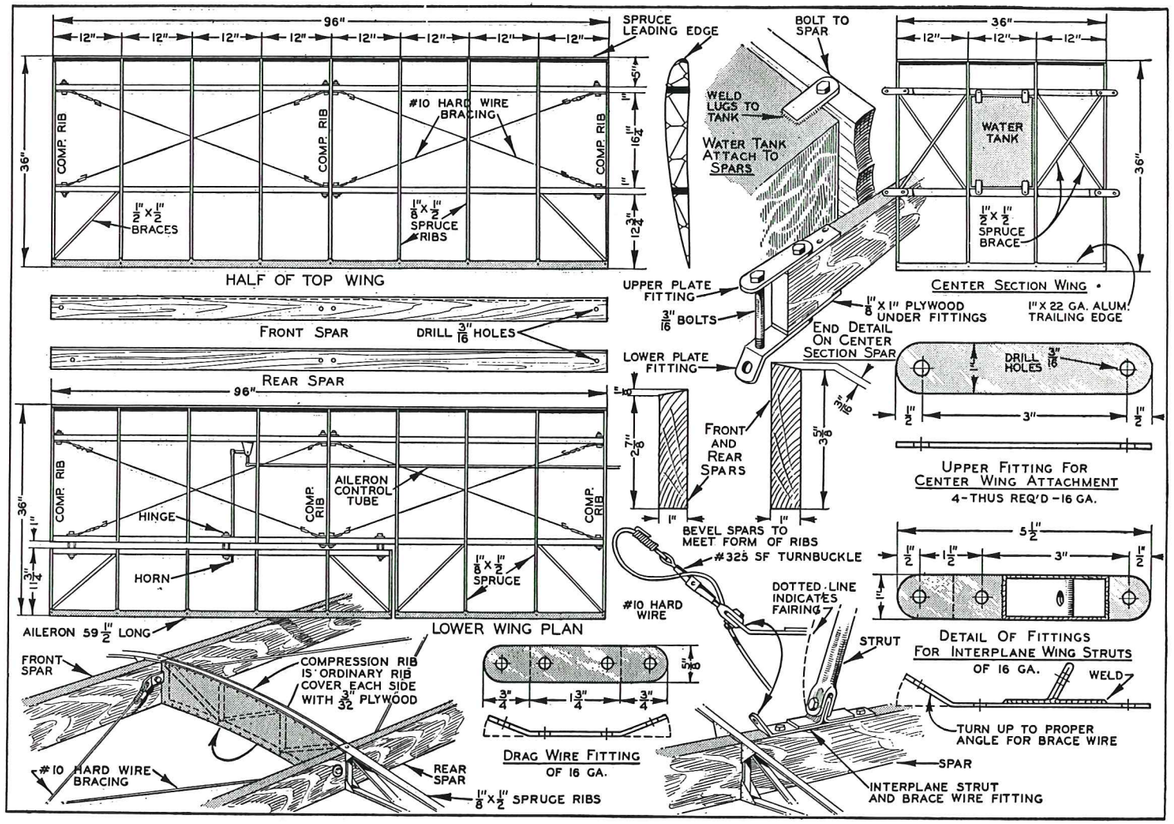
CAUTION: To avoid confusion and costly mistakes do not rely on your own judgment for going ahead of the text instructions — read to the final word!



In this drawing clearly shown in outline Benday on the crankcase is the purpose of the set of holes marked "X." When you have centered them, drilled them and used them as the text directs, stop! See further drawings before going ahead. In the meantime, rest your eyes on the Longster at left, coming in for a landing towed by a "Harlequin."



Here's a nice view of the motor from above. Neat, what? The offset rocker assembly seen at the left of the crankcase is mentioned in the cross-section diagram of the motor and is fully explained in a later installment.



Working drawings of the wings and center section are given here. Note the position of the surge tank in the middle panel of the center section. A further improvement would be to place this tank on one side and the gas tank on the other. The center panel could then be braced as shown in the drawing. Tips of the wings are square for simple building.

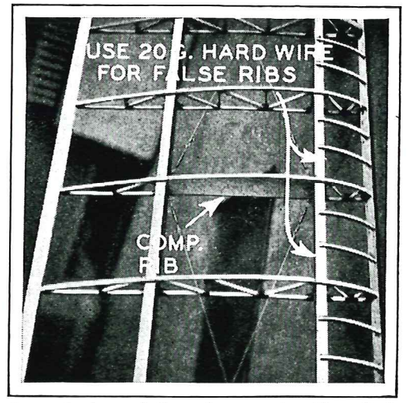
written knowledge necessary to build the Gere plane from the plans furnished here.

Now having got that off my chest let's proceed with the work in hand:

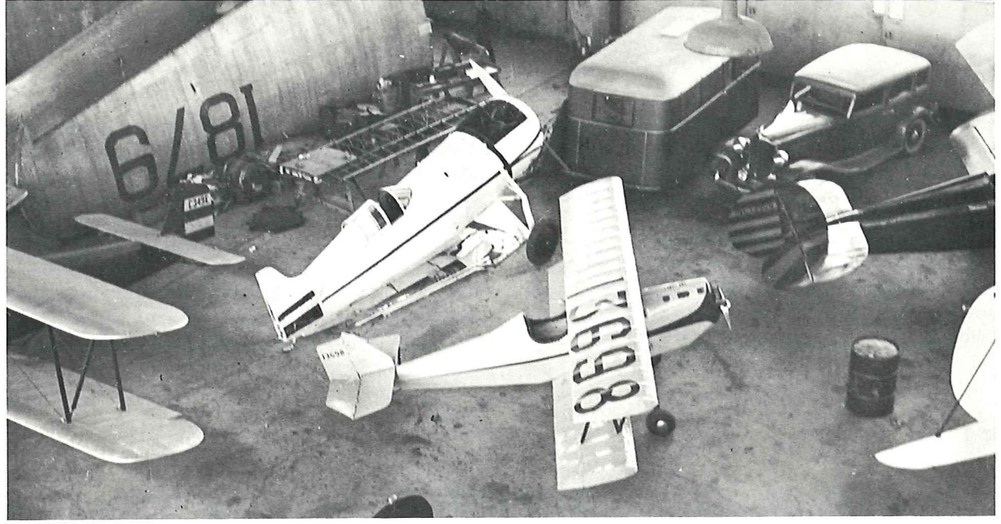
The Wings

You will see by the drawings and photographs that the wings are cut off square at the tips. This eliminates the making of curved tips, which are hard for most amateur plane builders to make all alike. There is so little loss in dynamic effect in using a flat tip on a plane of this size and type that the additional work involved in making curved tips is not warranted.

The spars are designed large enough to permit the use of pine if spruce is not available, but spruce is recommended. They are 1 in. thick. The depths of front and rear spars respectively can be obtained from the working drawings. The spars are not routed to form I beams, as difference in weight is so slight that it would not pay to have it done in a mill and to rout them by hand is a tedious operation requiring a good deal of time and care. Top and bottom edges of the spars should be beveled



A good view of the wing construction. It is suggested that 20 ga. steel wire be used for the false ribs instead of shaped aluminum, as used on the original job.



Gere Sport built by A. S. Smokovitz, Vulcan, Mich., in 1934. Powered with a 60 hp Dayton Bear engine.



(Photo by Jack McRae)

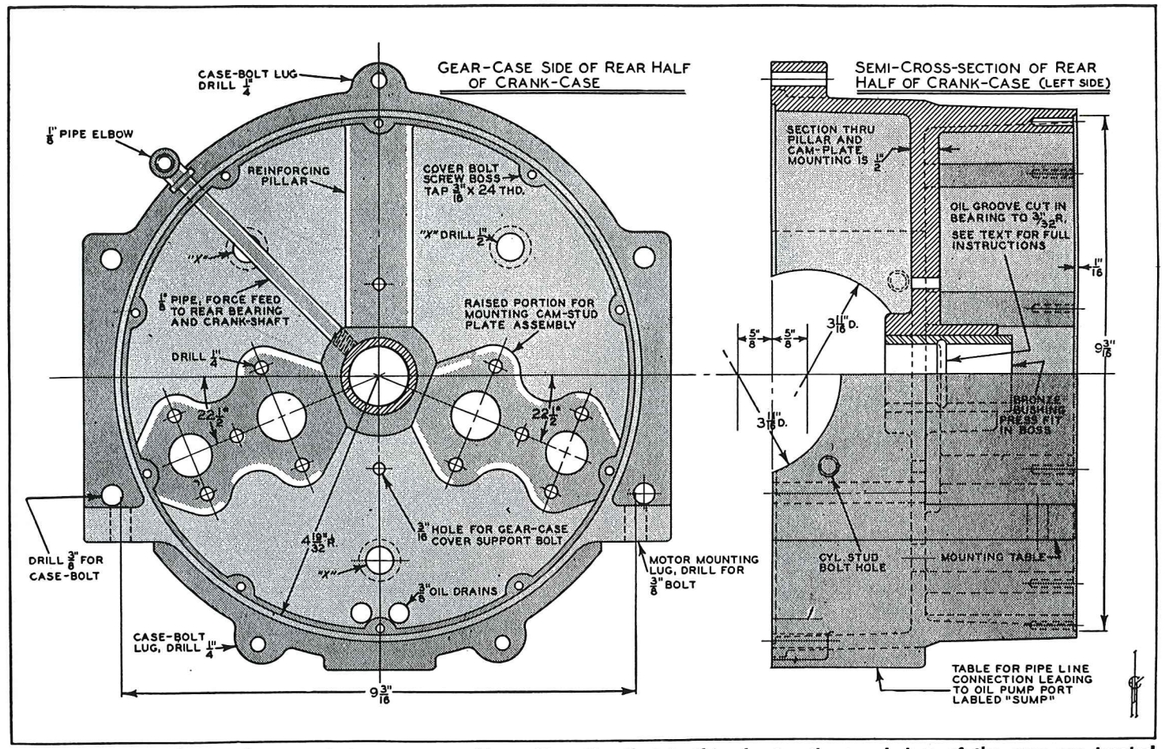
the plans and pictures which accompany this article there is little doubt in my mind that you will feel inclined to agree that he just about hit the mark.

As mentioned in the previous installment, everything has been done to try and make the accompanying working drawings self-explanatory. It has also been explained that through unfortunate circumstances the builder of the original ship was unable to complete the plans himself.

Now it is literally impossible in the limited space at our disposal to cover every single detail of any airplane design and the prospective builder must be prepared to exercise a certain amount of ingenuity and generally use his own head. These remarks are particularly directed to those who may feel the urge to write in and complain that I have not covered the entire ship.

My personal opinion is that builders will always take certain liberties with one or more details of the design they are reproducing; and for various reasons, not the least of which is the desire to incorporate some little improvement of their own — fancied or real — into the finished job. Which seems to me a healthy attitude deserving nothing but praise *so long as the important features of the design are not tampered with.*

For the builder who is tackling his first job and who therefore is rather at sea when it comes to tackling some of the construction operations I can think of no finer advice than to recommend the purchase of a copy of the 1932 Flying Manual. This is literally a mine of information and contains not one but several airplane building articles. Written as they are by different designers and specialists, these articles are of unusual value to the amateur builder and a careful perusal of this volume will put the reader in possession of just about all the



The rear half of the crankcase and the gear case. You will notice that in this chapter the two halves of the case are treated separately. In the next plan the text carries the whole case as a unit to completion. Do not attempt to drill or finish even the smallest detail until you are instructed to do so, because from the point reached by the manuscript to this point, each operation is dependent upon some other for its accuracy. Therefore, the routine plan of procedure insures perfect fitting in all parts. Certain points may appear to have been left out of these drafts, (as you will notice in studying castings), but they will be accurately shown in following plans.

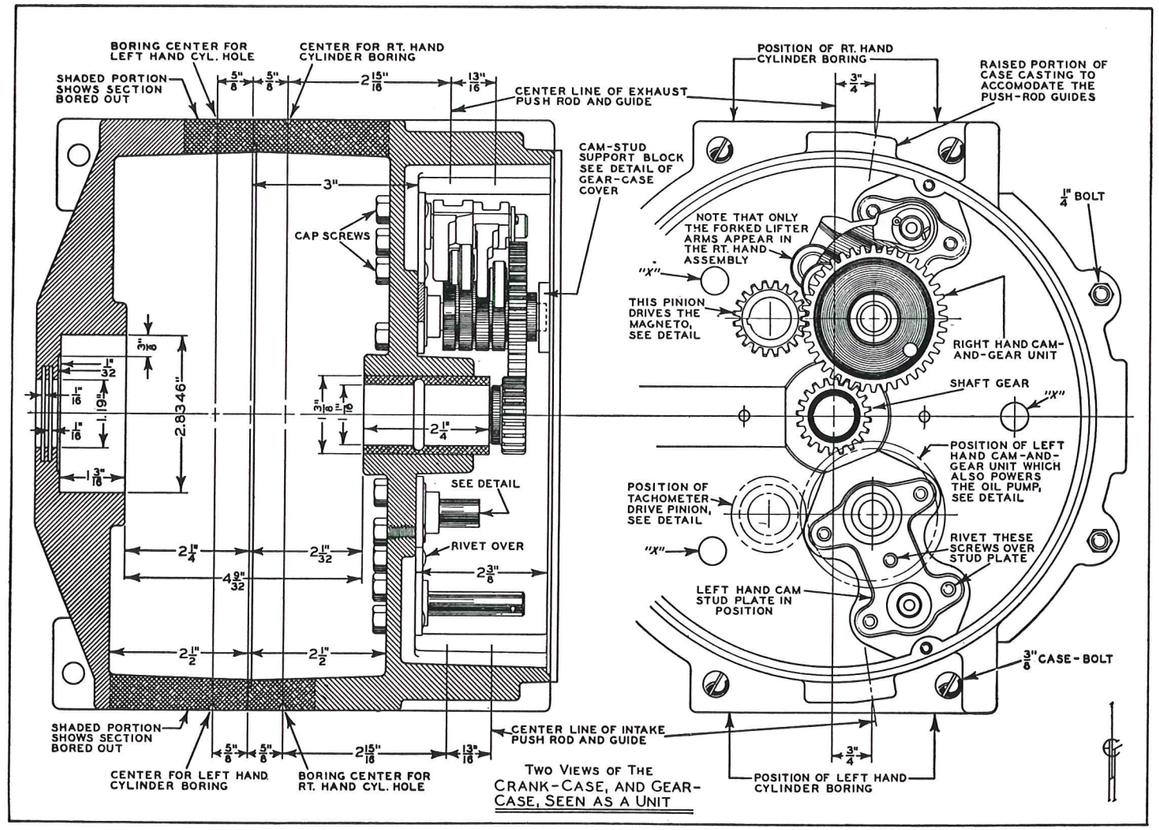
the center line. This locates the four centers for facing and cutting the cylinder skirt holes. Drill clear through with a ⅛ in. drill and then enlarge for centers.

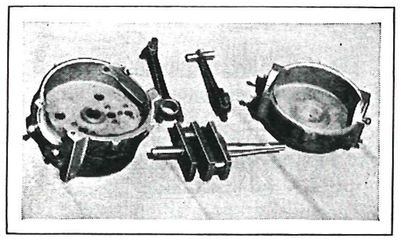
The method used should be plain. Let's say we do the left side first. The case is centered in the two forward centers and driven with a dog. First the whole side of the case is faced off to a distance of exactly 5¼ in. from the crankshaft line. Then a hole 3-11/16 in. is cut for the cylinder skirt, but not clear through. Leave at least ⅛ in. of metal at the bottom of the cut. The case is now reversed and centered on the rear pair of centers and the same procedure gone through on the right side, again not cutting quite through for the skirt. The case is now taken from the lathe and the metal removed from the cylinder hole by a sharp rap with a hammer.

The case will now have two flat sides, spaced exactly 10½ in. On the right side there will be a 3-11/16 in. hole with its center ⅝ in. to the rear of the center line, and on the left side the hole will have its center ⅝ in. forward of the center line. It will thus be seen that the center lines of the cylinders are 1¼ in. apart, which is closer than usual and one of the reasons the motor has so little vibration.

New parallel lines as before should now be made on the smooth cylinder flats. Extend them clear back to the rear of the cam case. Using the lines and the center lines as base lines, locate and drill the cylinder stud holes. Tap these ⅜ in. U.S. Next drill the long crankcase bolt holes. Take the case apart and locate the positions on the center line face of the rear half. Drill ⅜ in., straight through as shown.

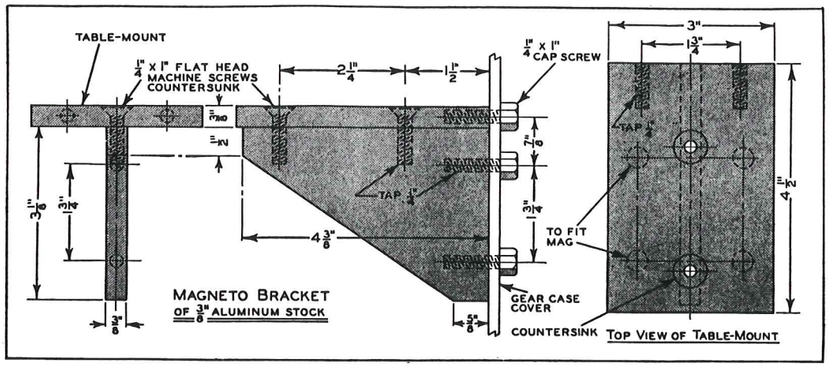
Place the two halves together and mark down thru these holes to locate those on the front half. The two upper ones are drilled clear through, ⅜ in. The two lower are drilled in 1 in. and then for the rest of the way are tapped for ⅜ in. SAE. These lower holes do not go quite through. The upper long bolts are standard N.S. bolts and nuts. The lower two should have their heads filed round and a slot cut for the screw driver, as they are screwed in from the rear. In speaking of right and left sides of the motor it is understood that we are looking at it from the rear.





The case unit shown here in cross section has sufficient information lettered thereon to be self-explanatory. The right hand cam and lifter arrangement is shown in position in one of the views. The timing is regular Harley. Method of timing is well explained in the accompanying article, but if you encounter difficulties any motorcycle shop can set you straight. One of the beauties of the Harlequin motor is the fact that its simplicity and use of standard parts makes it difficult to go wrong with it.

The con-rods, the crankshaft, and the two halves of the crankcase. Pretty, aren't they?



Magneto bracket fits close to case, allowing direct geared drive without complicated arrangements.

leave the motor mounting and cowling until the very last, as the only practical way to establish a perfect balance is by moving the motor an inch or so forward or backward until the proper position is found and checked.

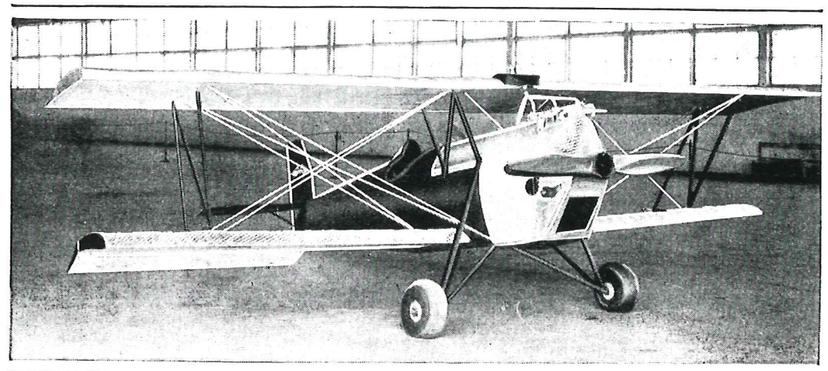
Fairing and Cockpit Details

With the fuselage now completed in skeleton form, landing gear in place, and all fuselage fittings securely welded in position, the next logical step is to construct the turtle deck, attach the side fairing and install the seat. All these operations are described in minute detail in these drawings. The instrument board may also be cut to shape and fitted in place. The cowling forward of the pilot's cockpit can be forgotten for the time being, as there still remains a good deal to be done inside the fuselage itself. Some of these, the control system, the gas tank, etc., and also the wings and the tail surfaces will be the subject of the second and concluding chapter dealing with the Gere plane. • • •

PART 2

Wing Details of GERE Sport Biplane

This chapter shows plans for building the Gere Sport Biplane wings, tail assembly, controls, and control surfaces. When you've finished your ship you'll have a light biplane that is the last word in modern design.



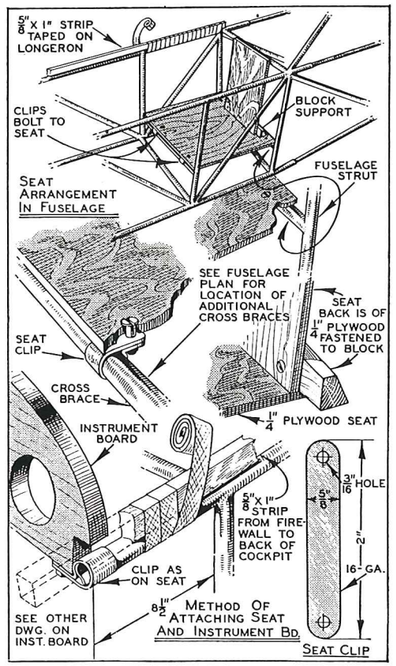
This excellent photo of the Gere Sport Biplane speaks for itself. Good design, clean lines and beautiful workmanship.

by DOUGLAS ROLFE

In case you fellows who have followed this article think I am hipped on the subject, let me confess to a weakness for biplane design. Amateur builders as a rule do not have very much flying time behind them and therefore need a plane which will stand a good deal of banging about. Now, rightly or wrongly, most training ships are of the biplane type and from this we may assume that the type is particularly well suited to hard usage if not actual abuse. Certainly it can combine rugged strength with low weight — two factors which are of supreme importance in any lightplane design.

"The writer's purpose in designing this plane was to make a lightplane that would perform like the ordinary commercial or training plane and be of modern design and construction throughout the entire structure . . . the factor of safety often is maintained throughout and is greater in many places" (from the unfinished notes of George [Bud] Gere).

After reading Bud Gere's stated reason for designing and building this ship and after digesting

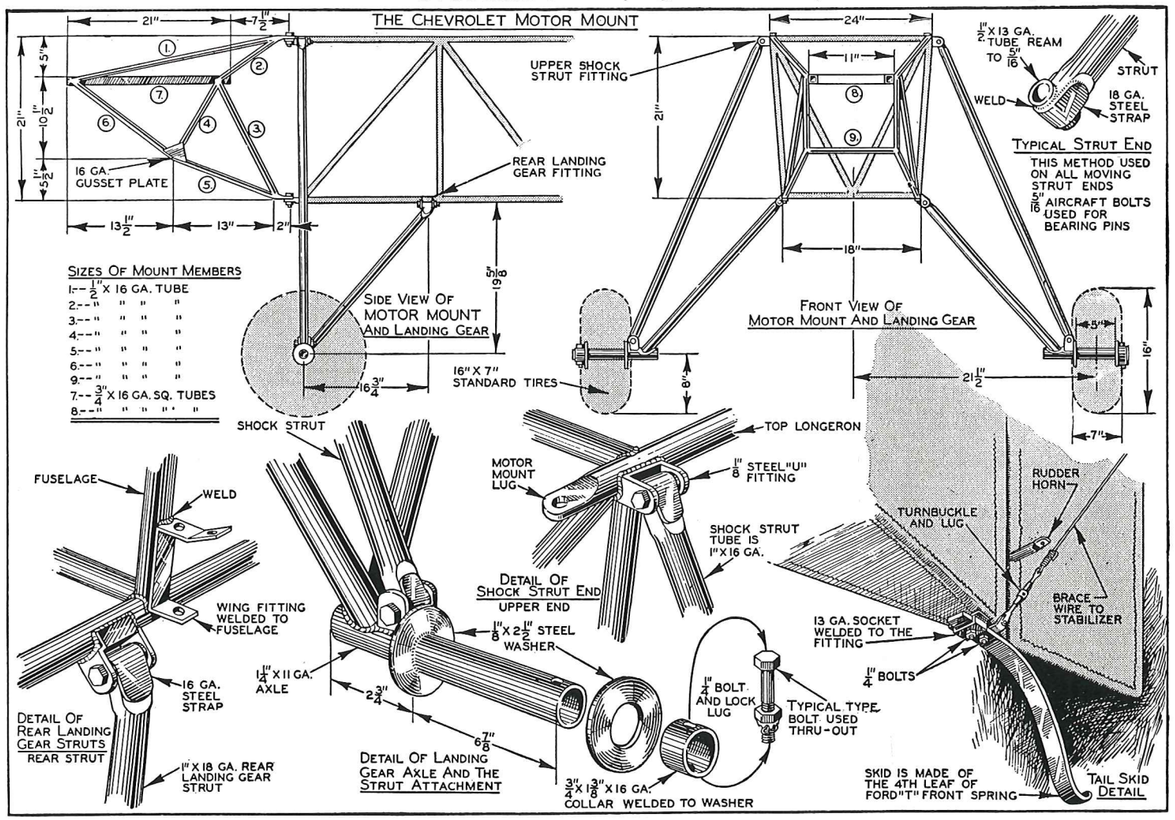


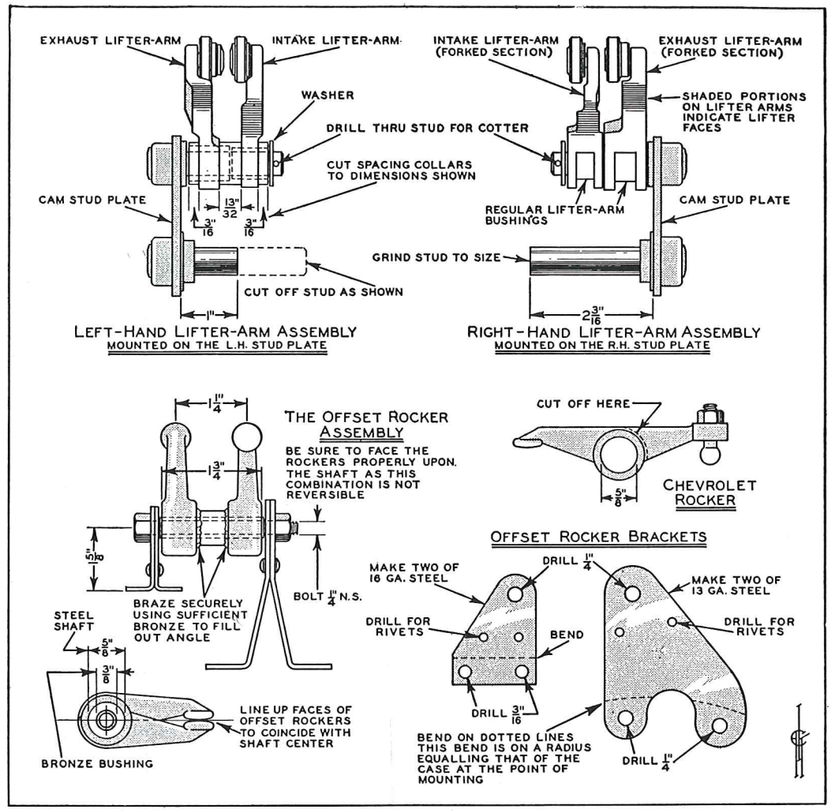
Seat construction and further details of the instrument board and its manner of attachment are shown in this plate. Tape is used to bind wooden members to longerons.

60 hp, the details of the motor mount will depend almost entirely upon the builder's choice of a power plant. A mount suitable for a Ford "A" installation has been suggested. Complete details of this type of mount can easily be obtained from the 1932 FLYING MANUAL, where it is described in connection with the plans for the Pietenpol Air Camper. Similar data can be obtained on the Ford "T" mount by referring to page 36.

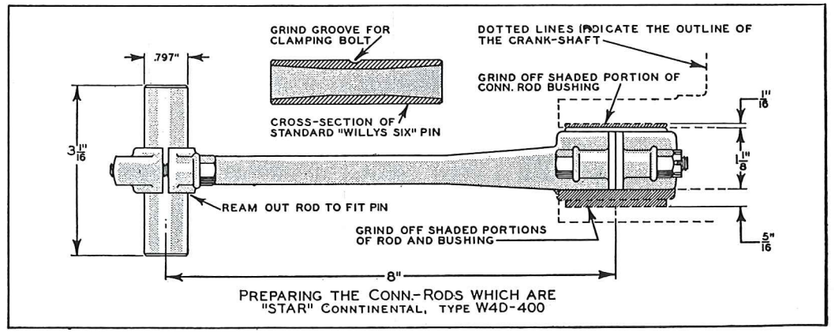
Although the Chevrolet engine is not recommended, we feel that there will be a number of builders who may wish to install this engine temporarily. The plans for this mount are consequently given in some detail. One more word on the subject of Ford conversion motor mounts — and Chevrolet. If either of these motors is used, it should be set back a full 4 in. more than the plans show. This change is the result of test flights made since the plans were drawn. In any case, the best bet is to

Complete dimensions of the Chevrolet motor mount, and the landing gear are given on this page. The tail skid is simple, being made from the fourth leaf of a Ford Model T front spring, bent to the shape shown in the drawing.





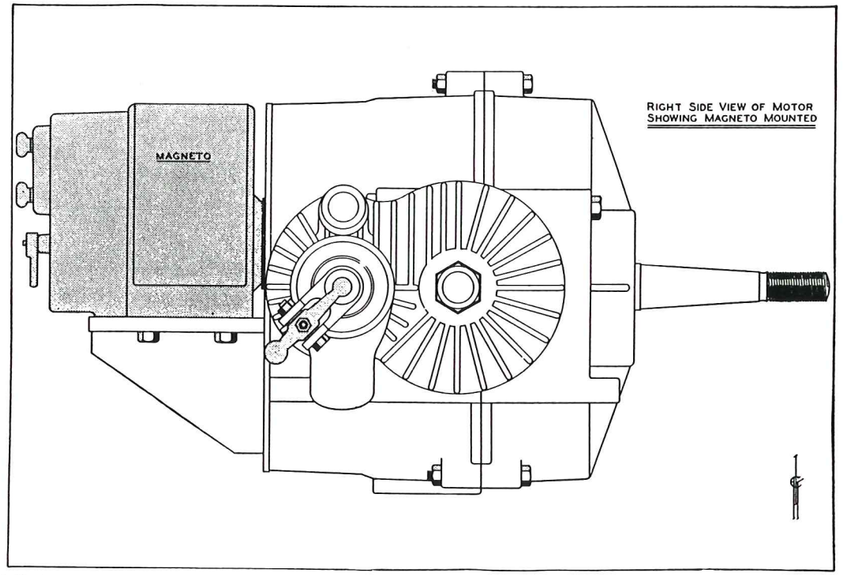
Con rods are prepared according to these instructions. Use great care in grinding down the crank end of each rod to insure a perfect fit. The offset rocker assembly should be carefully done. Line up the faces of the arms perfectly and see that they are directed correctly when they are brazed on the shaft. The brackets must be fitted to the case. The only dimension given for these is the height of the shaft center from the cylinder bed. Lifter assemblies present no difficulties.



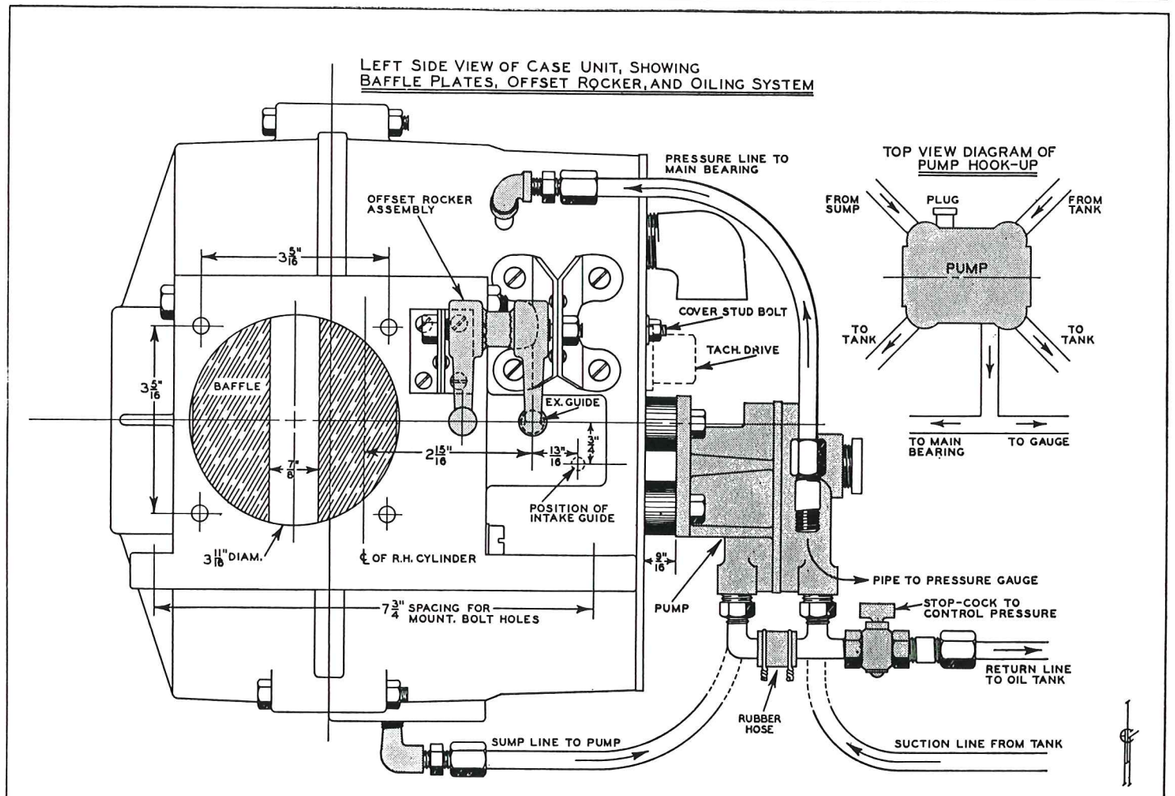
Two regular Harley cam stud plates should be secured and the large studs ground off as shown. The small studs should be heated at the ends so they may be drilled for cotters. Lay the rear half of case down with the gear case up and scribe a line that is square across the case, through the center of the shaft hole, the ends of this line meeting the ends of the parallel lines on the outside.

Below this line, on each side scribe a line on the faces of the bosses that are placed there for this purpose, a line that is at an angle of 22½ deg. This is plainly shown. On these lines locate the holes for the large knobs on the bottom of the stud plates. Drop the stud plates in position and mark through the five holes for the ¼ in. bolts. Drill these holes. Tap out the holes in the plates to ¼ in. U.S. They need not be drilled, just run the tap through them. Bolt both stud plates down securely with ¼ in. cap screws and rivet the ends of the bolts.

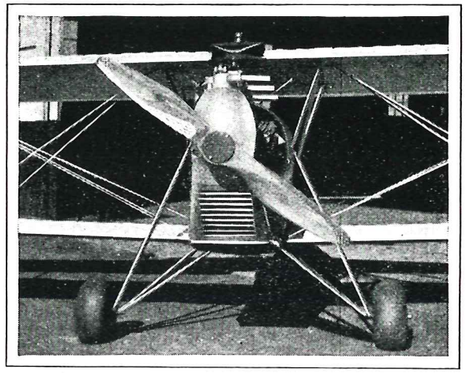
All this may sound a trifle complicated, but it is really very simple. If you have a set of the full-sized blueprints everything is made so plain you cannot go wrong. The alloy case works easily



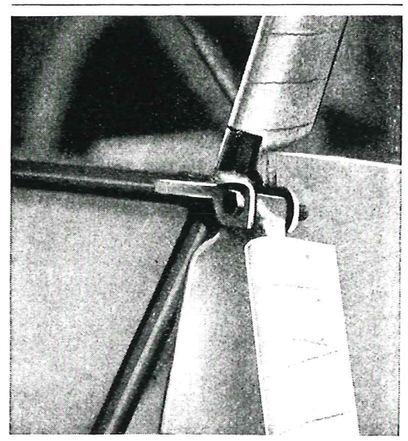
Compact arrangement of magneto in relation to motor shown in this outline view of the right side of the engine.



The oil lines may be fully understood through this plan. Do not allow sharp bends in the tubing; 5/16 in. line is used throughout with the usual fittings. Note the directness of lines to various parts of the motor. Use great care in fitting the offset rocker assembly into position. This is an unusual feature of the Harlequin and must be assembled with absolute precision. The position of the oil baffles is clearly shown and no difficulty whatever should be experienced with them.



Frontal view shows clearly the extreme simplicity of the rugged landing gear, and gives a good idea of its business-like appearance.



Closeup of vertical landing, or shock strut, and upper motor mount lug. Welded center section strut as completed on original ship is shown here. It is suggested in this article that this connection be changed to a moving strut end.

and welded into slots cut into the slightly projecting longerons immediately forward of station No. 1. In no part of the fuselage is more care essential than at this point. Remember, the entire motor installation depends upon these four lugs and their perfect security!

Miscellaneous Fuselage Fittings

Now we can turn to the lugs for the landing gear, center section struts, flying wires, lower wing fittings, and the tail group. All these are made from 1/8 in. C.R.S. They are put in their respective places and welded on. In the original design the center section struts are welded directly to the upper longerons at stations No. 1 and No. 2. This *may* be done, but our advice is to make moving joints of these points of attachment, in which case four more fittings should be made exactly like the front landing gear fitting and welded into place on the upper longerons at stations 1 and 2.

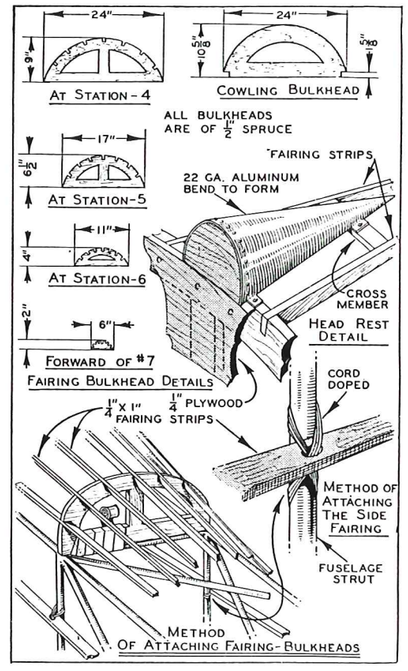
Details of the landing gear struts, by the way, are clearly shown both in photographs and detailed drawings illustrating this article. Two front wing fittings and two rear ones are needed. They are all made from 1 in. by 1/8 in. C.R.S. and shaped as shown in the detail drawing. As the front spar is 3-13/16 in. deep and the rear spar exactly 3 in. deep, the fittings should be shaped to accommodate these sizes. Both front and rear fittings are extended and bent as the sketch shows to form lugs for attaching the wing bracing. When all the fuselage fittings are welded in place, the entire fuselage should be thoroughly coated with a good dose of linoil.

The Landing Gear

The landing gear is our next point of interest. This is shown in such extreme detail that additional comment is superfluous. The tail skid, a painfully simple member in the Gere design, is also taken care of on this page of detail and should be made and fitted at this time.

The Motor Mount

This is an open question. As this ship is adapted to practically any type of motor *not exceeding*



Details necessary to complete the turtle deck, the streamlined head rest and the side fairing are shown on this plate. Note the doped cord method of attaching the side fairing.

weighing 300 lbs. (the total weight of the ship, less motor, is only 305 lbs.!) and developing a doubtful 19 hp is in itself a striking tribute to the soundness of the Gere design.

So, when you build your Gere plane, plan on using either a "T" or an "A" Ford engine, or, if you want a young pursuit job, try and lay your hands on a Szekely 40 radial. Best of all, build a "Packmag Twin" and step out with the best of 'em. Complete conversion plans for the Model "A" Ford are published in the 1932 FLYING MANUAL.

You will observe that the subject of converted motorcycle engines has been studiously avoided. They are absolutely unsuited to the Gere design and should be avoided as the plague. Now to take up the actual construction.

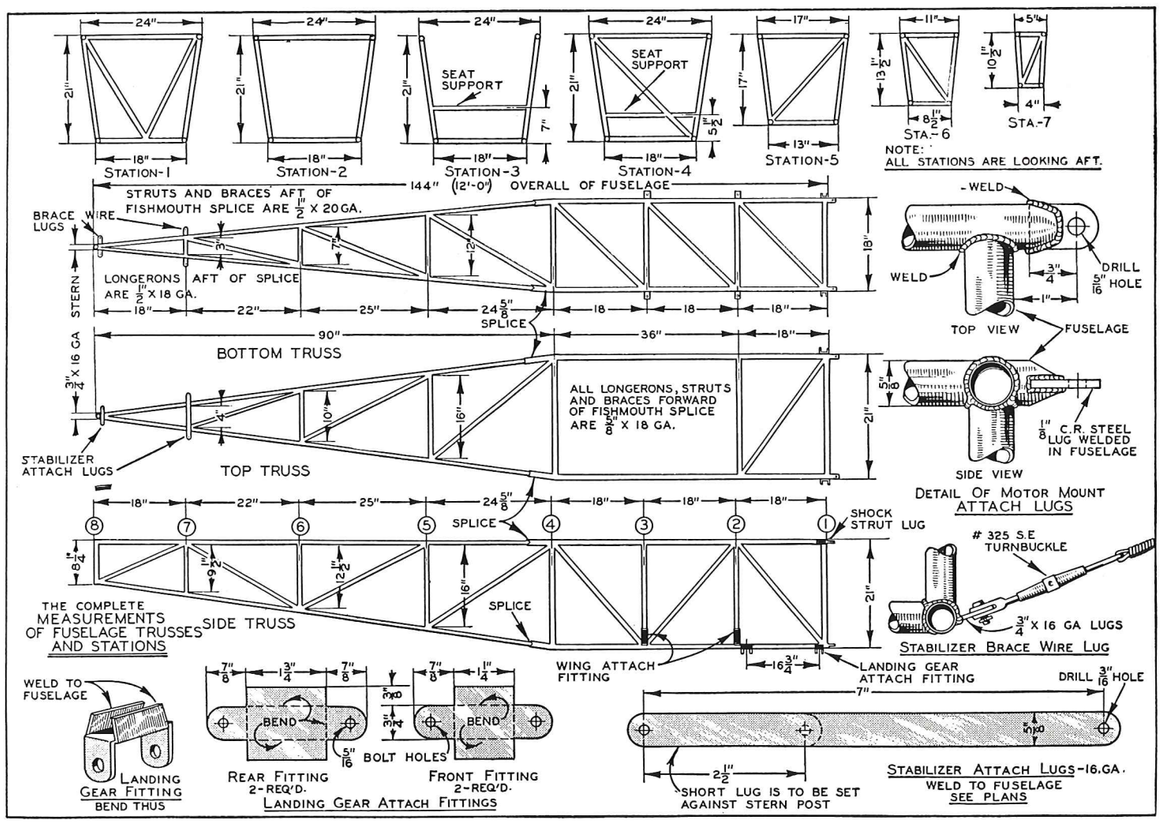
The Fuselage

Building a steel fuselage is a precision job. Furthermore, the welding *must* be done by someone thoroughly versed in the noble art. Slipshod methods, never to be condoned but which occasionally pass muster in minor details, are absolutely *out* when it comes to the fuselage or indeed any of the welded fittings.

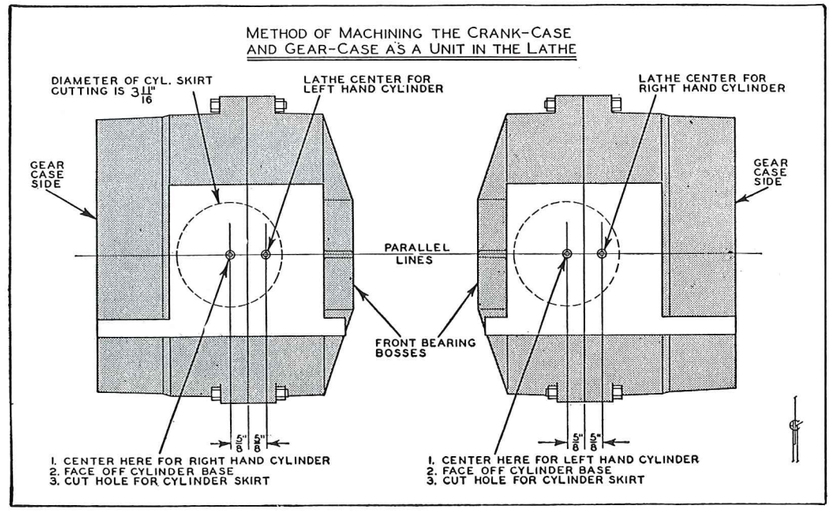
Study the plans for the fuselage carefully. All sizes and measurements are given in the drawings and it would be a useless waste of space to repeat them here. It is also of little value to give literal instructions on the actual steps necessary to build the fuselage, as this information is available in graphic form in the 1932 FLYING MANUAL. On page 11 in this publication Mr. Pietenpol covers the subject in the clearest possible manner. With the exception of the dimensions, which naturally follow the Gere plans, the procedure is identical to that described so thoroughly by Mr. Pietenpol in the article referred to. He also takes up the matter of the longeron splice which occurs in the Gere fuselage.

The Motor Mount Lugs

When the fuselage structure is completed the next step is to make the motor mount lugs. These, as can be seen by referring to the plans (see also photos and diagrams on accompanying pages), are made of cold rolled steel (C.R.S.) and are inserted



Complete lines of fuselage layout and miscellaneous fuselage fittings are given on this page. Welded tubing is used, since the design is in strict conformity with the latest approved practices in plane construction. Welding must be carefully done. Follow the plans closely and do not depart from them in any respect. You might improve the design—and you might not!



The text explains in detail the procedure to be followed in machining the case — here's how to center case in lathe.

and the job is interesting and instructive. The castings are nearly to size when you start so that there isn't much to do. With the case bolted together again, take a large file and smooth and level off the mounting tables on each side, keeping the two tables parallel so that the engine will set squarely on its mount.

Your engine is now ready for the various accessories and smaller parts. Let's do up the rods. These are the regular Continental "Star" rods, type W4D-400. Get them babbitted. Grind and file off the faces as shown, so that the large ends will slip freely in the crank throws. Scrape them to a fit that will just allow them to fall with their own weight when tightened tight. Use Prussian blue and proceed exactly as you would on your car bearings. Try to get a "90 percent fit." Get a pair of standard Willys Six piston pins of the size shown. Ream out the small end of the rod to just take this pin. Grind a notch in the center of the pin to pass the clamping bolt as shown.

The cylinders and pistons are, of course, regular Harley. If the cylinders are in good shape they will need no change at all. If worn much they should be honed out. The pistons are the type known as Dow metal. Do not try to use iron pistons. If the cylinders are ground and new pistons fitted it is well to use the .030 over-size type. The clearance at the top should be .020 and at the bottom .007. This is regular Harley practice and any of the motorcycle crowd can keep you right on it.

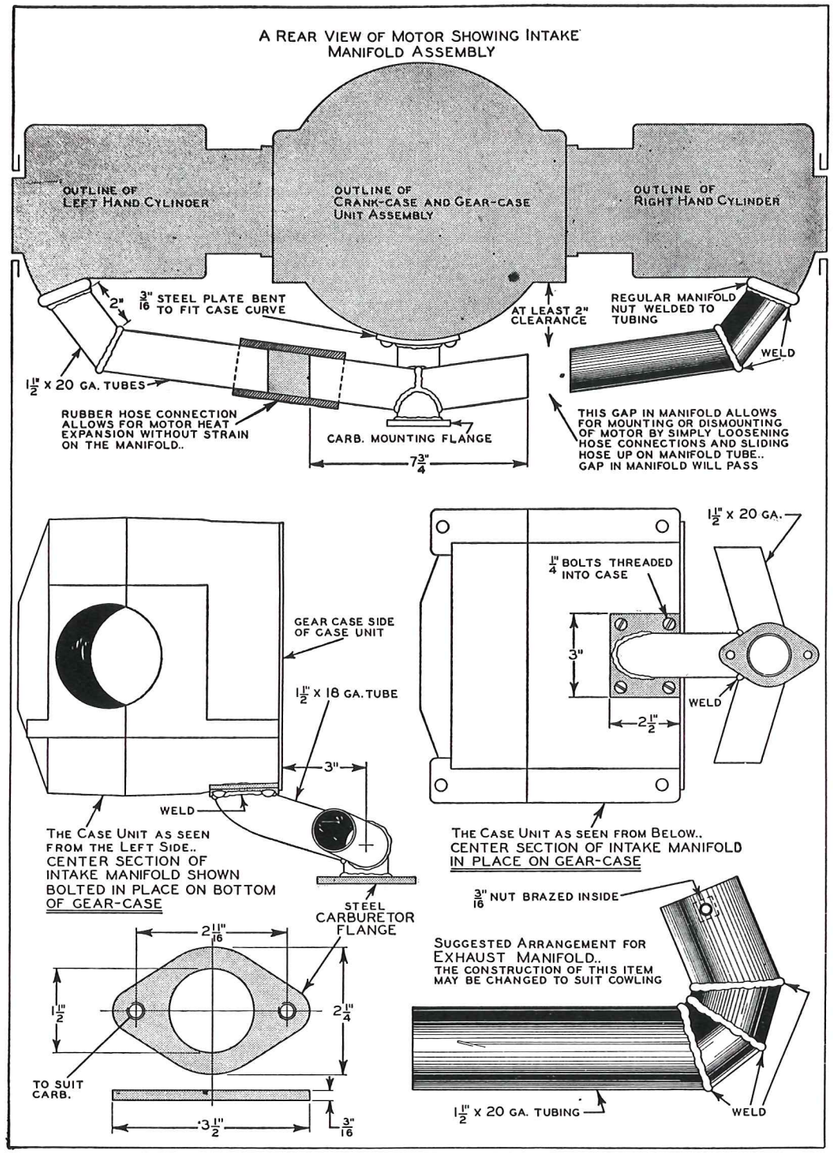
The pistons are reamed out slightly to take the Willys pin. Valves should be ground if needed and the guides put in good shape. The stud in the top center of the cylinder should be sawed off flush and the priming cock hole plugged.

We might as well set the pushrod guides now. For the right hand cylinder the location is practically the same as on the Harley. The exhaust guide is exactly on the parallel line and at a distance of 2-15/16 in. from the center of the cylinder. If you prefer you can take out the exhaust valve from the cylinder and run a long rod down the valve guide and mark the case in that way. Be sure the cylinder is setting true on its seat if you do this. The hole is then drilled and tapped 5/8 in. SAE. The intake guide is offset the amount shown and as the thread is not a standard we always use a 1/4 in. pipe tap, running it barely through from the top and then running it up through from the bottom. This makes a good fit. If the holes are drilled true the push rods will seat squarely on their proper positions on the lifter arms.

Special Rocker Arm

The left hand set is done exactly the same as the right. Remember that they are directly in line with the left pair, no allowance being made for the offset in the cylinders.The offset is taken care of by the special rocker arm which we worked out and which does its work to perfection. It is made of a couple of Chevrolet rockers, about 1926 model. The main thing is to get the kind that have a bushing with an outside diameter of 5/8 in. Knock these bushings out and saw off the end that has the adjusting screw as shown. Turn up a piece of shafting for a good drive fit in the rockers and drill a 3/8 in. hole through it.

Drive the arms on this, seeing that the centers of the tappet faces are exactly 1 1/4 in. apart. Be sure to get them on right-side-up as the thing is non-reversible. Get the two tappet faces both in line with the center line of the hole and then braze them securely. Use plenty of bronze, filling out the angle between the rocker shoulder and the shaft. This draws part of the temper, so after brazing heat the tappet faces nicely red and plunge in wa-



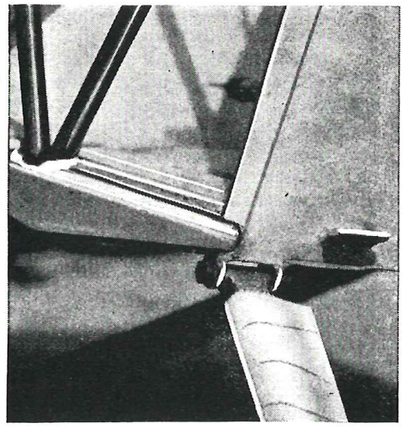
The principal point of interest in the design of this manifold arrangement is that in mounting or dismounting the motor, all that is necessary is to disconnect the two rubber hose connections and the gap left in the manifold will allow the motor bearers to pass easily. The drawing is self-explanatory. Exhaust manifold arrangement may be changed by the individual to conform to style of cowling chosen.

ter. This should bring them back so hard a file won't touch them. The bushing that goes through this rocker is bronze or steel, about 1/16 in. longer than the rocker and with an outside diameter of ⅜ in. It has a ¼ in. hole through it for the mounting bolt.

Must Get Perfect Fit

The brackets that hold this rocker are hard to describe, but are not hard to make. The patterns for cutting are shown full size and if these are used for templates no trouble will be had. No exact dimensions are given or needed. After making the brackets assemble them on the rocker arm. Put the left hand cylinder squarely in place and set the bracket and rocker assembly on the case. Line things up so that one rocker tappet face is exactly over the push rod coming out of the gear case and the other squarely under the exhaust valve stem. Mark the holes to be drilled right through the holes in the brackets.

The small bracket, of course, sets on the cylinder flat and should need no adjustment, but the large one sets on the rounded gear case and the feet should be bent with pliers until it sets neatly. For the small bracket tap right through the case for 3/16 in. machine screws and rivet them over on



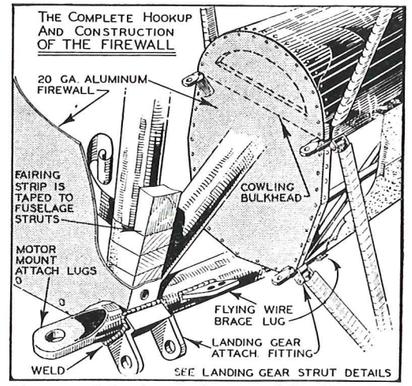


Photo at left shows closeup of landing gear lug and other important members. Drawing above explains construction of these parts and shows a simple treatment of the fire wall.

one-place biplane of practically all-steel construction it may be put down, structurally speaking, as one of the finest lightplanes ever built. There are many advantages to the biplane type, particularly when speaking of lightplanes, and this is especially true when the plane is to be built by an amateur.

In this direction and others the Gere plane seems to fill the bill exactly for anyone who wants a real honest-to-goodness airplane that is not only well designed but also has definite class. Anyone who has had the good fortune to examine the ship as Bud Gere himself conceived and built it is bound to be impressed with the clean lines, the simplicity and ruggedness of construction and the great possibilities of the design. It is difficult to realize that this is the work of an amateur designer and builder. Every detail is so carefully worked out, the finish so excellent and the common-sense attitude of the designer so apparent in every phase of the construction that it would do credit to any reputable aircraft manufacturing concern.

Welding Requires Care

While the straight lines, squared-off wing tips and simple landing gear make it easier to build than many lightplanes, it is just as well to face facts and recognize that here is a plane employing welded tubing and welded fittings for every important member except the wings. Those who can't do a good job of welding (or who are unable to obtain the services of a competent welder) had better not monkey with this design.

Another matter which might as well be taken up right now is the choice of a power plant. Although the ship was completed with a Chevrolet engine and the accompanying plans consequently deal with this particular installation, there is not the slightest doubt but that Bud Gere, had it not been for his untimely death, would have installed a more suitable motor. While the Chevrolet motor will serve for straight hops and possibly some field flying, it is emphatically *not* recommended to those who see in this design an answer to their prayer for a speedy, sturdy little sport job. The motor in question is altogether too heavy and the power output too low.

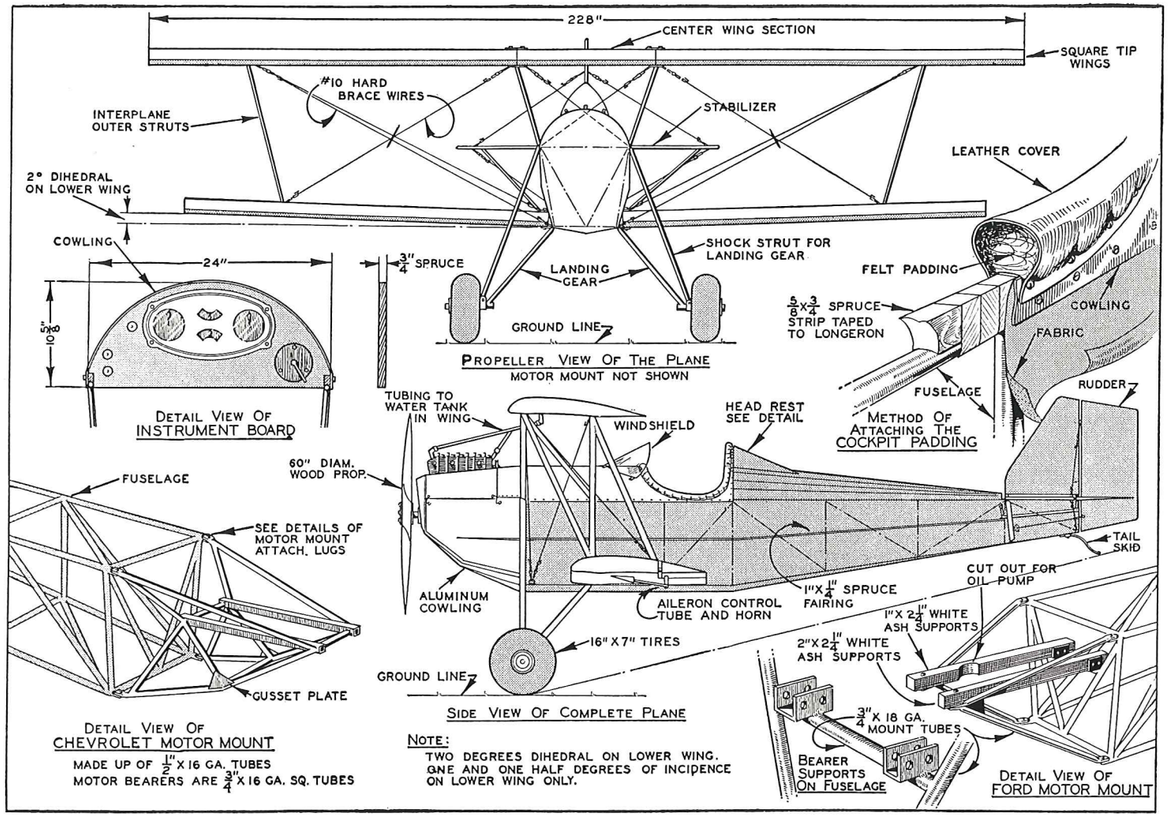
We recommend for practical use either the Model "T" or Model "A" Ford engine. These two motors have proven satisfactory under strenuous flying conditions and are furthermore easily adapted to the original Gere design. To supplement this recommendation a suggested Ford motor mount is incorporated in the accompanying plans.

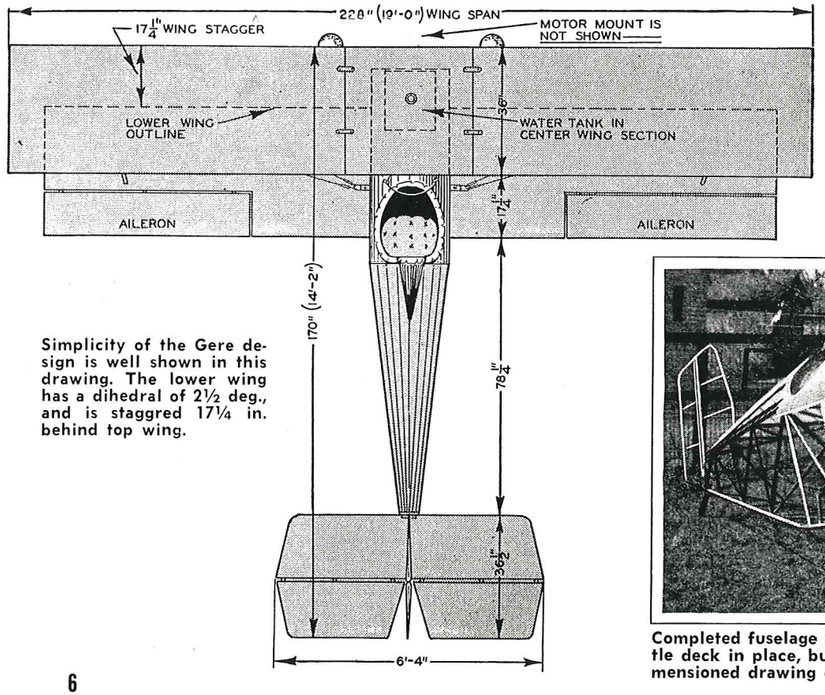
For those who can afford it the Szekely 40 hp radial (three cylinder air-cooled) is about the best bet. With this engine complete with drag ring the Gere plane will make one of the snappiest little sporting jobs ever turned out — the sort of ship you could take to the National Air Races and feel warm all over because you happened to be the owner-builder.

Another motor well worth considering, especially for those who would like to build their own power plant too, is the "Packmag Twin." It has ample power, same as the Szekely, and has such low frontal area that it makes an ideal motor for this plane. Complete plans for the "Packmag Twin" are available from MODERN MECHANIX AND INVENTIONS blueprint department for $5.00. Castings are also available. Ask for prices.

Now, in spite of our recommendation that the Chevrolet motor should not be employed, it is only fair to point out that the ship was actually test-flown with one of these engines and did in fact behave surprisingly well. Pilot Elmore Wall, who conducted the tests, has nothing but praise for the flying qualities of the ship and waxes enthusiastic about the behavior of the controls.

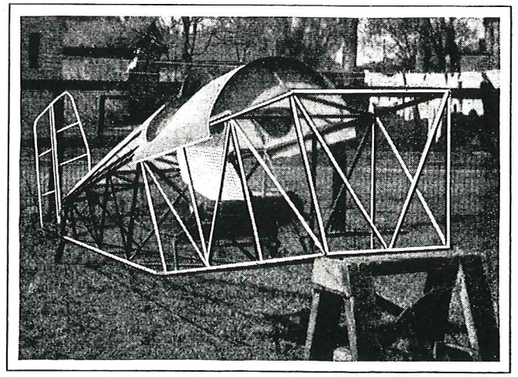
This latter fact is something worth mulling over, as the most persistent criticism of the lightplane as a class hinges almost entirely upon its reaction to the controls. As Elmore points out, the very fact that the ship flew so well with a motor



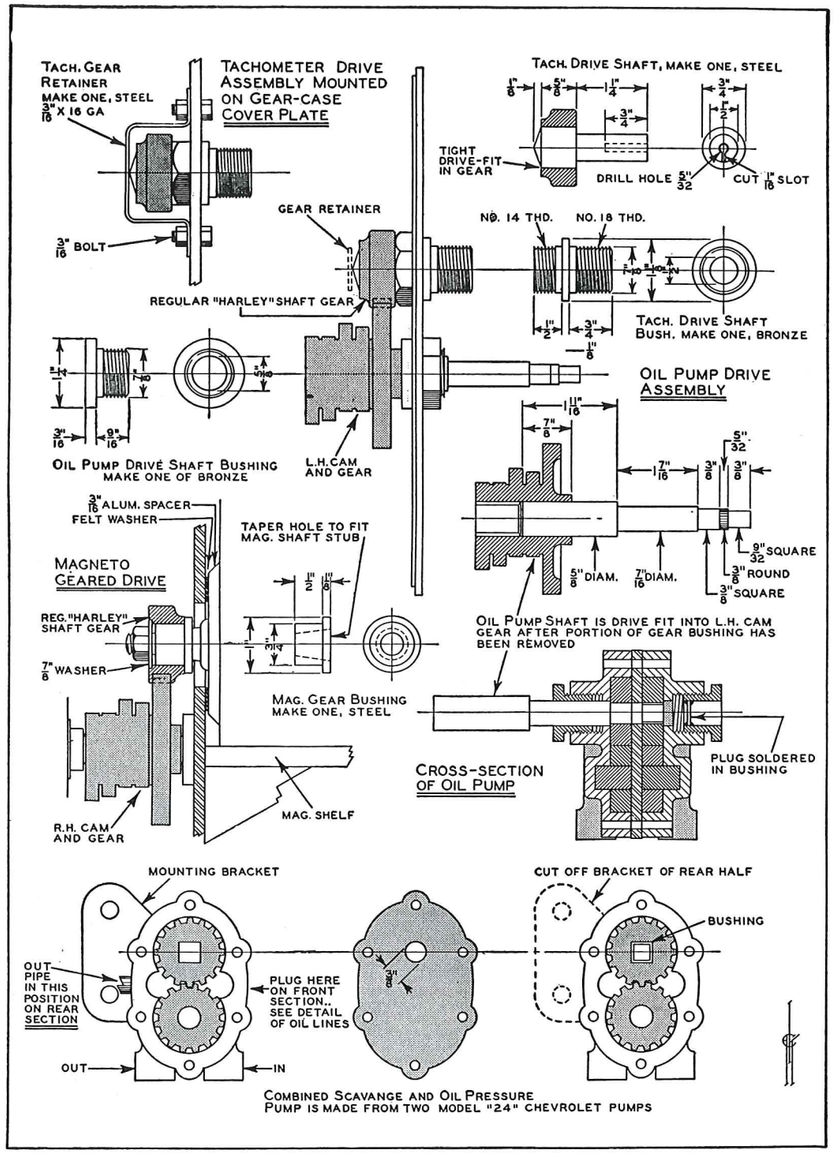


Simplicity of the Gere design is well shown in this drawing. The lower wing has a dihedral of 2½ deg., and is staggred 17¼ in. behind top wing.

Both Chevrolet and Ford motor mounts are given in this drawing. The Chevrolet motor is suitable for short hops and field flying, but it is not recommended to those who want to get full efficiency from the clean lines of the plane. A Model A Ford motor is recommended as being probably the most satisfactory compromise between price and power.



Completed fuselage structure with cockpit fairing and turtle deck in place, but without side fairing. Check with dimensioned drawing on opposite page.



The tachometer drive follows conventional practice. Methods of powering the magneto and oil pump are characteristic of the entire design of the motor—simple, compact and entirely satisfactory. Note the neat idea brought out in the oil pump. It's compact, double-acting and not difficult to set up. Two Chevrolet pumps, obtainable cheaply from any wrecking yard, are used in making up this unit.

the inside. Use ¼ in. cap screws on the large one, or if you prefer, ¼ in. bolts and nuts. An oil hole should have been drilled through the center of the rocker arm barrel and a few drops of oil given it at times. This rocker arm solves a tough problem in this type motor and after once made works like a charm. The intake push rod system requires no change for the left hand cylinder.

The next thing is to make up the gear case cover from the sheet of 17ST Dural furnished with the castings. Turn out a disc a trifle larger than the outside of the rear end of the cam case. Turn the rabbet to fit the one already turned on the casting. They should fit snugly the same as those at the center line of the main case. Note the drawing of the cover carefully and you will understand the positions of the various holes. You can scribe center lines at right angles and lay the cover off with a rule, or it is much simpler to lay the blueprint directly on the cover and prick the centers for all the holes through it. It is best not to drill the holes for the pump shaft and tach drive bushings full size at first. Drill them say ½ in. and then lay the cover in place and see if they are going to fit. If not, work them until they do.

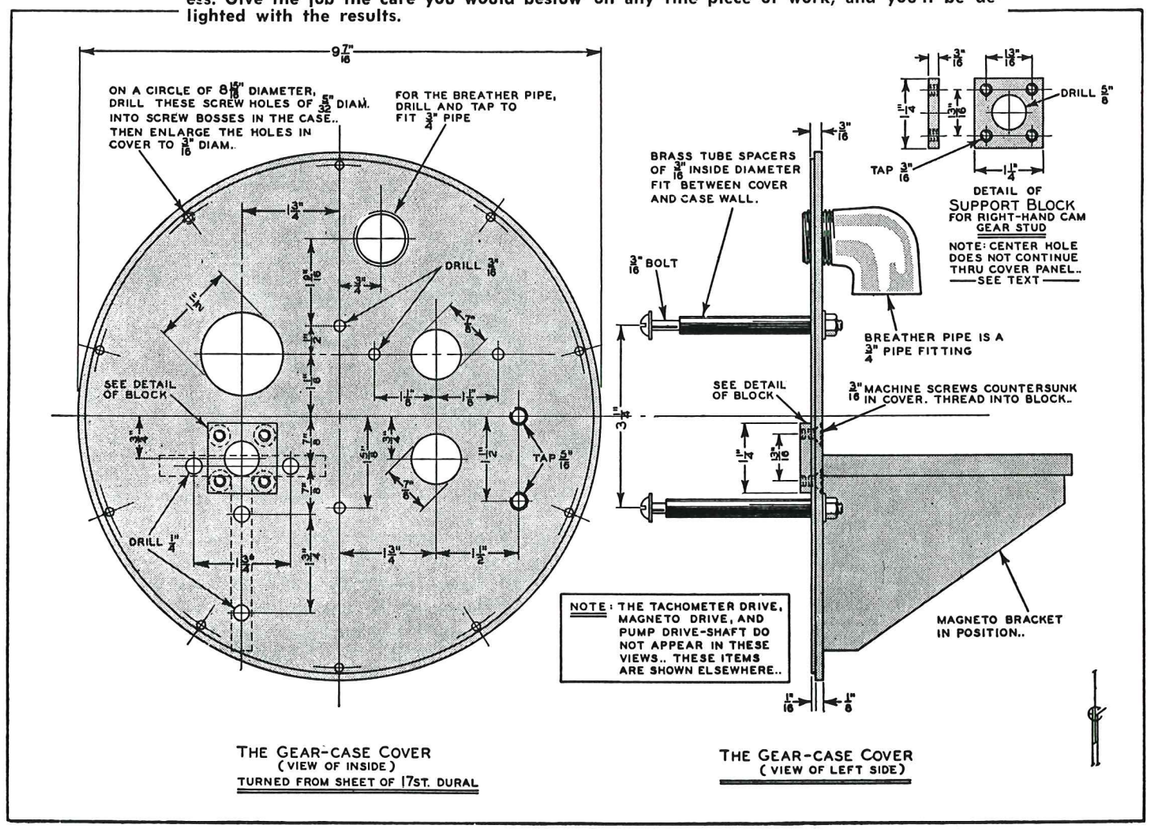
You will notice on the drawings a piece of 1¼

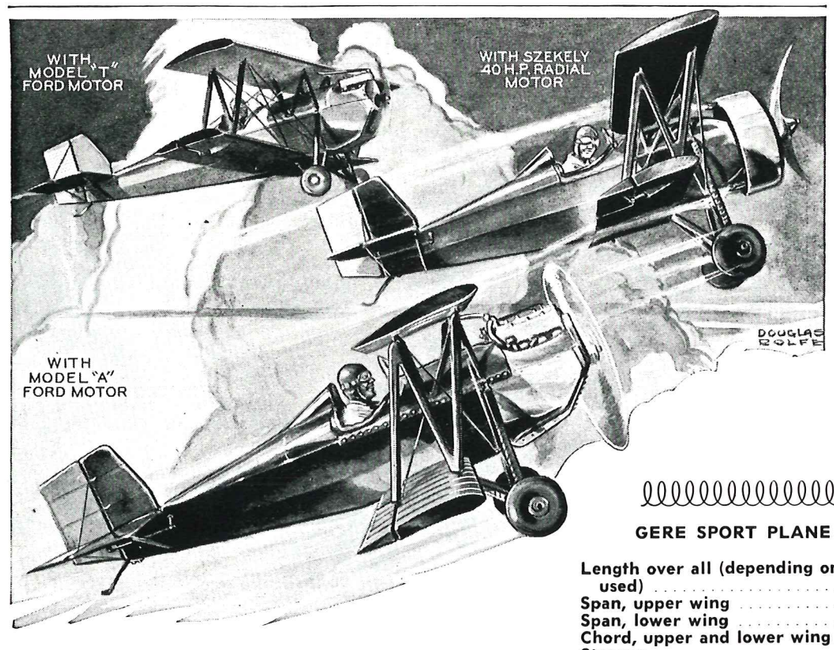
in. by 1¼ in. by 3/16 in. Dural screwed to the cover on the right hand side. This is to support the right hand cam stud. The best way to locate this is to put a touch of paint on the end of the stud and then drop the cover in place. The paint will show where to put the supporting block so that it will fit without a chance of binding. The slightest error otherwise would make it impossible to get the cover on, as the stud must fit snugly in the hole in the little block. With this done you can look right down through the hole for the left hand gear arrangement and see that it is in line.

Make up the tach drive bushing and the pump shaft bushing of bronze as shown. The nuts used are ordinary nuts sawed in two. Make up the tach drive shaft and drive it tightly in its gear, which is the regular Harley shaft or breather gear. The entire tachometer assembly should be put in place and held by the retaining strap shown. The pump drive shaft is now made up. Use N.S. shafting and make it exactly to the dimensions given. The first thing to do is to drill out the outer half of the bushing in the cam gear. Simply take a ⅝ in. drill and run it a trifle over half-way through the gear, thus removing that part of the bronze bushing. Turn the end of the shafting so that it makes a very tight drive fit in the gear. Drive it in and then chuck up the gear and protruding shaft and finish the turning. This is so the shaft will be true with the gear. Check the gear carefully, both for center and for wobble. You will notice that there are two places where the shaft is square. Do this with a file, keeping these parts nice and truly square. It should be plain that this left hand cam gear bears partly on the regular cam stud and partly in the bushing in the cover.

Tap the hole for the breather. This is a plain ¾ in. pipe elbow. Make up the magneto bracket of ⅜ in. aluminum stock as shown and bolt it on. You will notice that we use a much simplified magneto drive arrangement, which is the reason we can use such a small and neat bracket. You

The gear case cover is made from a sheet of 17ST Dural, which is furnished with the castings if you buy them from Long. This drawing shows how the case is drilled for breather pipe, tach, magneto, and oil pump drives, but installation of these latter units is shown on a separate drawing. Study the text closely when working out this unit, for the author gives you useful pointers out of his own experience which will greatly simplify the building process. Give the job the care you would bestow on any fine piece of work, and you'll be delighted with the results.





The simple and exceptionally rugged construction of the Gere design permits it to be equipped with a wide variety of power plants. A Model T or Model A Ford motor will give good performance. With a Szekely 40 hp radial engine, complete with drag ring, the Gere bears a striking resemblance to the very latest army pursuit planes.

GERE SPORT PLANE SPECIFICATIONS

Length over all (depending on motor used)	Approx. 16 ft.
Span, upper wing	19 ft.
Span, lower wing	18 ft.
Chord, upper and lower wing	36 in.
Stagger	17 in.
Angle of incidence, upper	0 deg.
Angle of incidence, lower	1½ deg.
Dihedral, upper	0 deg.
Dihedral, lower	2½ deg.
Maximum speed, with Ford A motor	80 mph
Maximum speed, with Ford T motor	75 mph
Maximum speed, with Szekely 40	95-110 mph

which had been his labor of love for months, was done except for installation of a motor. Bud's father, familiar with the plans and hopes of his son, carried the ship through to completion with the assistance of friends who had worked with Bud during the hours when his creation was taking shape. The Chevrolet motor which Bud had been converting was finished up, cowling installed, and Elmore Wall took the ship up in a test hop.

Results were so satisfactory that the editors of the 1933 FLYING MANUAL take great pride in presenting the complete plans for the Gere Sport Biplane. The ship, as will be seen from a study of accompanying photos, is reminiscent in appearance of the latest type of army pursuit plane. No finer piece of craftsmanship has ever come to my attention. The job is so well built that it would be a distinct credit to both the designing and construction departments of any up-to-date airplane factory.

Now Owned by University

Additional testimony as to the technical excellence of the plane — if any were needed beyond its performance in its trial flights — is afforded by the fact that the original ship has now become the property of the University of Minnesota. Prof. John Akerman of the University's department of aeronautical engineering was so impressed with the Gere biplane that it now stands in his class room where groups of engineering students can study it. Prof. Akerman himself is noted as the designer of several production planes, and his seal of approval is just one more bit of evidence as to the favor with which aviation experts have accepted Bud's ship.

When the editors asked me to prepare a set of plans for F M readers who have been clamoring for plans of a ship as efficient as the Pietenpol Air Camper but of biplane rather than monoplane construction, I was both pleased and dismayed.

Plans Presented Step by Step

Pleased because from what casual knowledge I had of this ship I knew it to be an unusually interesting airplane — dismayed because I realized that only the builder could do justice to the difficult matter of presenting a "how-to-build" article of his own design. This being impossible, I have endeavored to present in the most lucid and concise manner the step by step procedure necessary to reproduce the Gere design. The drawings and photos which accompany this article have been chosen with great care, the intention being to cover every important detail of the construction in such a manner that they will be practically self-explanatory. To Mr. George Gere, Sr., and others who have been of assistance to me in preparing this article, I wish to extend my thanks.

Before going into the details of the design a few words are in order about the ship itself. As a



George E. (Bud) Gere, Jr.

EDITOR'S NOTE: The Flying Manual is proud to present these plans for one of the neatest light biplanes that has ever been designed. Unfortunately, the how-to-build article could not be written by the designer, George (Bud) Gere, Jr. While testing out an ice sled on January 18, 1931, he was struck by the propeller and suffered fatal injuries. At that time he had completed the ship itself and was working on the motor adaptation. Through the efforts of his father and of aviation friends familiar with Bud's plans, the ship was completed and successfully test flown last fall. Experts who have viewed it have pronounced it one of the finest lightplanes ever designed, and it will fill the bill handsomely for those readers who have been clamoring for a practical biplane design. The original Gere ship has been acquired by the University of Minnesota, whose aeronautical engineering department is using it in its classrooms as an example of fine design and painstaking craftsmanship.

PART 1

Plans for the GERE Sport Biplane

by DOUGLAS ROLFE

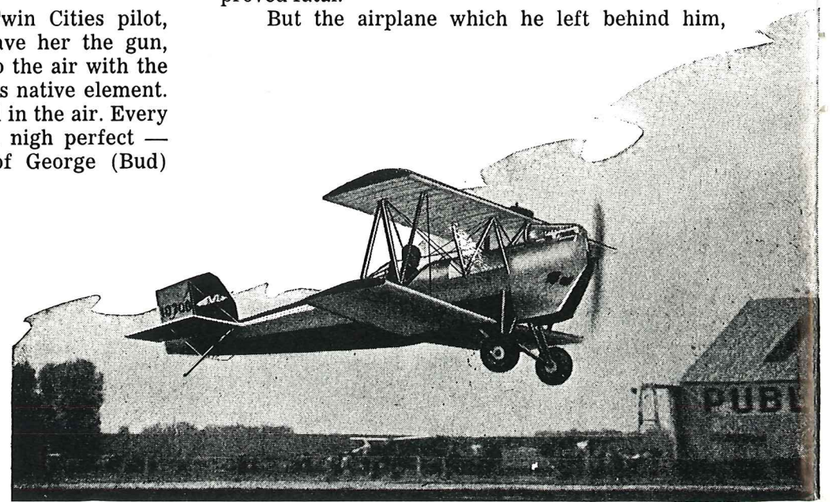
Late last fall, shortly before the snow began to fly, a trim maroon and cream biplane was wheeled out on the tarmac at Wold-Chamberlain airport in Minneapolis and made ready for its initial flight. The ship was a beautiful creation indeed, eliciting words of enthusiastic praise from the air-wise onlookers fortunate enough to be among those present.

Elmore Wall, well known Twin Cities pilot, settled himself in the cockpit, gave her the gun, and the Gere sport biplane took to the air with the eagerness of a bird returning to its native element.

She behaved wonderfully well in the air. Every aspect of the test flight was well nigh perfect — everything except the absence of George (Bud) Gere, Jr., the young man who designed and built her.

Bud could not be there. Weeks before he had gone out to White Bear Lake with a party of friends to test a newly built iceboat. In attempting to dislodge a frozen sled runner, Bud had slipped into the arc of the propeller and his injuries had proved fatal.

But the airplane which he left behind him,



Pilot Elmore Wall leaving Wold-Chamberlain airport in the little Gere. Note its resemblance to the modern pursuit ship.

may use nearly any type magneto you prefer. We use mostly Simms and Spli dorf. The type used will govern the style of the little gear extension fitting shown. The one shown is for the Splitdorf. The idea is to extend the gear far enough through the 1½ in. hole so that it will mesh properly with the R. H. cam gear. The end of the magneto must butt squarely up against the cover plate, with a felt washer between the two to keep it oil tight. If the magneto happens to have a rounded end, use an aluminum washer as shown. You will have to cut a taper hole in the extension fitting to fit the magneto shaft, and also two key seats, one for the shaft and one for the gear. You can make these with a file. After the magneto is fitted with its gear, which is also the regular Harley shaft gear, set it on the bracket and push the gear through until the two gears mesh properly. Then locate the holes on the bracket for drilling the magneto bolt holes. If the gears seem to bind, shim the magneto up slightly. The magneto used is a regular 4-cylinder type and, of course, runs at engine speed. This makes very easy starting. You will notice that there are no couplings, shafts, impulse couplings or other mess about this arrangement.

The drawings show two 3/16 in. holes in both the cover and gear case, one above and the other below the center. These are for studs to stiffen the cover plate. Simply cut two pieces of tubing having a 3/16 in. hole that will just reach from the case wall out to the cover. When making final assembly put these in place and slip a 3/16 in. bolt through, keeping the heads inside the crankcase and the nuts on the outside of the cover.

We can now drill the ring of holes to take the screws holding the cover on. Drop the cam gear having the pump shaft on the L.H. stud. Tighten the pump shaft bushing up snugly and drop the cover in place. If with the R.H. stud in its support, the pump shaft doesn't bind, everything is fine. Take it off. All around the gear case, on the outside make pencil marks opposite each screw boss. Replace cover and scribe an 8-15/16 in. circle. Opposite each of the pencil marks drill down through the cover and into the case about 1¼ in. Use a 5/32 in. drill. Tap the holes in the case for 3/16 in. by 24 thread round head screws. Enlarge the holes in the cover to 3/16 in.

You will see in one of the drawings how the main oil line runs to the rear bearing. Drill a hole approximately in the position shown to pass ⅛ in. water pipe. Drill so that the pipe will just clear the case wall. Run a long drill down through this hole and drill and tap the bearing boss for the pipe as shown. At this time we will mention a detail that was purposely not mentioned. Where this oil line goes through the bronze bushing a groove about 3/16 in. wide and 3/32 in. deep should have been cut in the bushing. Do this with a boring bar. This groove is to carry the oil around the crankshaft so that the hole in the side of the shaft is always open to the oil. The hole in the boss and bushing, the groove, and the hole in the shaft must all register. The distance of all three will be approximately 1 in. back of the front end of the bearing boss. Use a little thought on this. At the top of the ⅛ in. pipe put an elbow and copper pipe coupling.

The oil baffles may be put in now. They are shown plainly and may be of aluminum, Dural or brass. Fasten them with 3/16 in. R.H. machine screws. Using these baffles there is no need for oil rings and the motor gets just the right amount of oil.

And now we come to the gadget that looks bad, but is easy to do. It is the special double oil pump we worked out here. The advantages of a dry sump engine are so many we decided that was what we wanted, so we made it that way. Dry sump engines are lighter, free from smoking when upsidedown and have far less head resistance. The pumps are both in one unit. They are made of the regular Chevrolet pump. Get two of them at any wrecking house and with a saw and file trim the mounting bracket off one of them. The regular pump cover is as shown and the two pumps are placed face to face with the plate between them. Each part has its set of gears as usual, but you will notice that on the rear pump, which is the pressure part, the gear with the square hole is bushed so that it fits the squared end of the pump shaft.

This little bushing can be a strip of 20 ga. copper bent around in the hole and sweated in with solder. After the bracket has been sawed off the rear half the regular screw holes must be drilled clear through with a 3/16 in. drill. Ordinary stove bolts are used for assembling, going through the rear half and into the front half holding all together. Use the regular paper gaskets made for this pump. The pumps are from the older model Chevrolets. There are the regular packing nuts with the pumps. The rear one takes the shaft and is packed in the regular way. The front one is soldered shut as shown and screwed in tight. The pump is put on the cover after the motor is assembled, using the two 9/16 in. spacers shown. Don't be afraid to tackle this pump, it is quite simple.

The oil line layout is simple. The right side of the pumps is the input side. The small hole on the center line is plugged on the right side. The one on the left is used for the main pressure line and also to the pressure gauge on the dash. Look carefully at the drawings and it will all be clear. The stopcock to the rear of the rear pump regulates the pressure, which may be from 25 to 200 lbs. per sq. in. We use 80 lbs. and find it about right. There are two lines to the oil tank. The overflow from the rear pump is also joined by the scavenge side of the front pump. The suction line comes to the right side of the rear pump. The short line from the sump goes to the right side of the front pump. Use 5/16. in. line all around with the usual fittings.

The lifter arm arrangement is clearly shown. Take a set of regular Harley arms apart. Get a new exhaust and a new intake lifter bushing. The arms with the fork end are used on the right side of the motor. Slip the bushings in place and put the arms on the stud and cotter neatly. The left side set must have the spacers cut from tubing exactly as shown. Assemble them on the stud and cotter. Don't let them have too much play.

This brings us to the final item, the manifolds. No exact measurements are given. The drawings are quite plain. Weld up the center part and bolt it solidly to the bottom of the gear case. Braze in the 2 in. piece in the regular Harley intake manifold nut, after sawing off the outer threaded part. Then weld on a piece that will line up with the center part, so that the pieces of hose will cover the gap neatly. This gap takes care of expansion and allows the motor to be placed on its bed by slipping the hose to one side and dropping it in place. See that about 2 in. are left between the manifold and the bed plate on the case as the motor bearer goes between them. Use wire or hose clamps to keep the hose air tight.

The exhaust arrangement you may do as you like with to suit your ship and cowling. We use the simple little elbow shown. We take out the regular exhaust manifold nut and slip this elbow in the manifold. It is held by a screw going through a 3/16 in. hole drilled near the end of the manifold cast on the cylinder and one in the elbow to match. We braze a nut inside the elbow to take the screw.

This completes the job. It has taken a lot of words to describe it, but the actual work is really quite simple. Most of the things are perfectly obvious as you go along, and the majority of the parts have already been made to fit. Anyone who likes tools and machinery can't help enjoy making the engine, and there is very little chance of failure in any part. If the full-size blueprints are at hand you just can't go wrong.

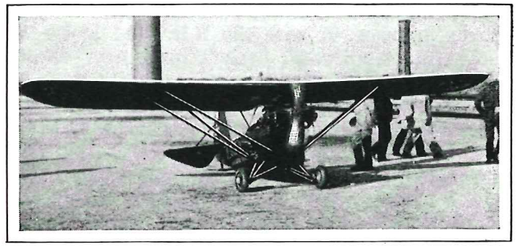
The timing is regular Harley. If you cut the key seat on the shaft in line with the throws most of the marks on the gears will check. However, you had better get a motorcycle rider to help you time it. Only two of the binding posts on the magneto are used, of course. The other two may be grounded. Time the magneto by setting a cylinder in firing position and setting the breaker so it is just cracked. Slip the magneto gear through the hole and in mesh with the cam gear and bolt the magneto down. The other cylinder will use a diagonally opposite binding post.

The carburetor flange shown is for regular 1¼ in. You may use any make you like, but we have found that the Winfield model M or S is by far the best for this motor.

With the engine on a test stand or in the ship it should be run for an hour or so at around 1,000 rpm to loosen up. Watch the oil pressure and stop frequently to see that the cylinders are getting the right amount of oil.

We recommend a propeller of 5 ft. or 5 ft. 2 in. diameter by 30 in. pitch. This depends on your ship, however. When your motor shows about 2,750 with this prop you are ready to fly. We think you will agree that this engine has the most ear-splitting, convincing roar to it you ever heard. It sounds like a whole flock of army pursuits coming. It is a real joy just to see and hear it work. •••

LIGHTPLANE LANDS ON FACTORY ROOF



The Continental powered Parasol as it landed on a block-long roof at Grand Rapids. The plane took off successfully a moment later.

Not satisfied with holding the lightplane altitude record and numerous speed prizes won at the National Air Races over a period of years, "Duke" Muller, superintendent of the Heath Aircraft Corporation of Niles, Mich., recently landed a standard Heath Parasol on a factory roof at Grand Rapids.

The only change made on the ship was a hook placed on the skid to catch a shock cord stretched across the roof as a safety device.

The roof of the building was 390 by 60 ft., and had 5 ft. brick walls all around it.

Muller took off from the airport, came over town, circled the roof once and then side slipped in for a landing. The wheels touched well past the center of the roof, but the Parasol, equipped with brakes and air wheels, took just 60 ft. to stop.

No damage was done to the plane or roof, and Muller took off right away and flew back to the airport. The Parasol was the LN type powered with a Continental A-40 motor.

Pick a good ship. See that it fits your needs. Use a good light, lively motor of ample power — *and first know how to fly before you try to test the job*. The age of miracles is past. Men don't teach themselves to fly now, and only at appalling loss of life have they *ever* done so. One in one hundred might. But the bills for repairs are many. The air is an entirely new element to the man who has not learned the controls, and he is a perfect sap if he doesn't first buy a hunk of information, a skilled knowledge by sitting dual for a long enough time to enable a qualified instructor to turn him loose on his own. That is so sensible and so obvious it hardly seems necessary. But similar advice in other lines go unheeded, too. Just the other day I saw a fellow climb into the ring with a little fighter who knew his business. The new gent was one of these guys who thinks well of himself and thinks he can do anything. He had it all over Pewee in pounds and strength and probably in guts. His eyes were good, he was younger, but — sad tale. He was so badly pasted around the ring by Pewee that it was pitiful. He just overestimated himself. A man learns to fight by fighting. And a man learns to fly by flying.

To a man who has mastered the art it is as simple as ABC. Nothing is more natural than flying to a man who has acquired the coordination necessary to make him at home in the air. Ever see a man get on a bicycle for the first time and ride right off exactly as he planned to after reading textbooks? Mother Earth and Prizefighters are gentler and have a quality of mercy. Gravity has no such quality and unless you learn to master her with a skilled touch imparted by another you are a bonehead if you try it. Tough talk, but fatherly and right.

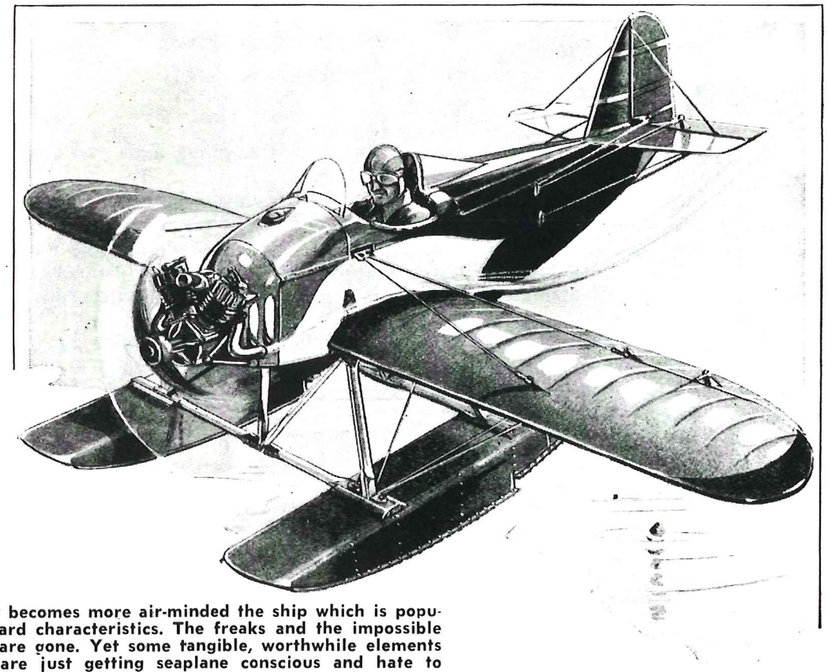
Now, as we go into 1933 we have before us in this book the finest selection of lightplanes 10 years of cut and try, as well as sound engineering, can give you. There's the Pietenpol Sky Scout. A great little ship if you haven't much money and want to use locally available materials.

The Gere job is a beauty for a man who wants a real airplane in biplane type. She'll handle a Ford really well and be a joy to all who love the biplane and her characteristics.

The Henderson Longster is eminently airworthy and has been tried and tested. She is ideal for small fields, and is in every sense a real airworthy lightplane.

The Corben* is the most versatile and probably the best tested and tried of the designs. It is presented as completely as is possible, and for you who want motors — who want to get into the air in the best way possible, we haven't skimped with the Cross Country Twin*— nor with the Long Harlequin. •••

* See special issue for these plans.



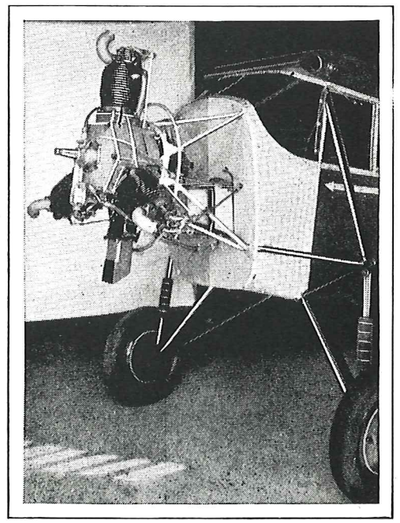
As everybody becomes more air-minded the ship which is popular has standard characteristics. The freaks and the impossible pipe dreams are gone. Yet some tangible, worthwhile elements remain. We are just getting seaplane conscious and hate to throw some features away. Above is such a ship — a V-twin wouldn't fly her, but the floats are desirable. Low wing is shunned by all but deep students who think they have a "lily" in the idea.

the test pilot of tomorrow saw 3 hp airplanes a reality, and he stacked the cost of 3 hp up against the old farm engine from Sears Roebuck out in the cream shed. Visions of owning an airplane appear. Little ships begin to be dreamed about. And by a slow process of incubation the youth-wide appetite started at Lympne kept getting hungrier and hungrier until the world thought it could fly in little ships and enjoy the sensation.

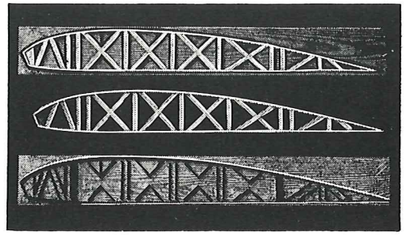
It was inevitable that Air Meets featuring little fellows would eventually be organized in this country.

Cleveland, in 1924, saw the American versions of the original English and German idea in the Dormoy Bathtub, and the Kreider Reisner Midget. Previously a seaplane had been designed by Muller, a cute but short-sailed little monoplane was designed by Dwight Huntington, designer of the Le Pere Fighter, and called the H-D 12 and there had been one or two sporadic attempts at lightplane construction using here a Ford T and there a Lawrence converted 28.

But Cleveland saw all the worthwhile ones together for the first time. The next year the Powell Racer, from whence sprang the recent Hickman-Powell racer, and the Snyder Baby Bomber, the Driggs Dart and one or two others appeared. Then as interest had lagged for lack of cash in England, the cudgel of lightplane development was definitely in America's hands, and Ed Heath, champion of lightplane builders, took the wings of the Thomas Morse Scout, put them on a little 13 ft. fuselage 18 in. square in cross section, and flew



Ten years ago lightplane bugs were satisfied with stick and wire, V-twin attempts, and most any design. Nowadays it is steel tube, stress analysis, and static load tests which they insist upon. Nothing less than the adequacy of the type of motor and mount shown in the Corben above will satisfy these ambitious dreamers. And it is well.



Wing ribs as well as the rest of the ship have evolved into simpler, lighter, stronger forms. Here's a modern rib. Contrast with the old cut-out style, costing $25.00 per rib.

into the field with a resounding wham!

The Heath Parasol and all later American lightplanes were developed on a scale which would have done credit to commercial builders five years before, and in 1929 with the first *Flying Manual*, the nationally popular magazine, *Modern Mechanix and Inventions*, put the sport of lightplane flying and building into its rightful category, differentiated it from the engineering elements found in the production of ships of the high-power school and definitely launched the American lightplane movement.

I was instrumental in bringing this American interest to a head, and was directly responsible for furnishing one plane plan every month or two months to the public for a long time. I take a lot of pride in being the man who focused the sun's rays on the subject with his little glass. That's natural, ain't it? If you've got a well developed aviation bump on your conk you can thank me as being the gent who started the big fire with his little can of kerosene. I hope you've liked it.

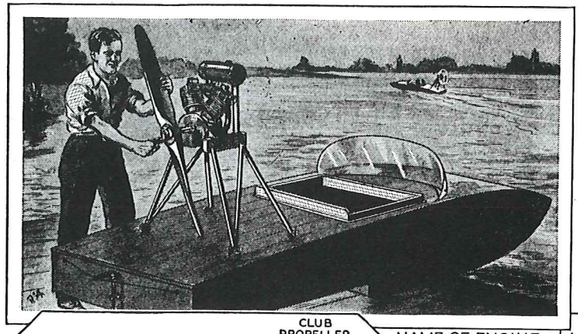
Naturally I've traveled the route this last 10 years with all things of interest to the lightplane fan. I've flown a good many lightplanes, and I've owned one myself. So I feel moderately qualified to come forth with a private pronunciamento after having seen the dummy of this issue of the *Flying Manual* and say to you that *this is the best manual* we have ever published.

But I may be able to tell you a few things about lightplanes that we have learned as we have gone along. It may be worth your while to turn a ready ear to this old Greasemonk on that score, for I have a lot of lightplant lore that just *is* right, and I've learned it through experience. Merely good sporting publishing to steer you right.

Pick out a ship that fits your needs.

See that it is well built and that it follows the plans.

Don't, for the love of Mike, play with anything but a good motor. A let-down generally is not serious, but who wants to play with a motor which has been resurrected from a long and noble life in some auto or motorcycle — its life has been lived and don't try to make it come to life through glandular overhaul. *It is not in the cards.*



Build a Hydroglider, Ice Boat Propellers in Your Workshop

by ROBERT L. DUMAS

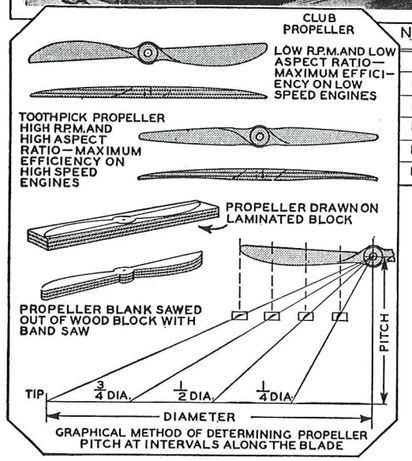


Fig. 1. Two conventional propellers suitable for use on ice boats and hydrogliders are shown at top. Props are built up from laminations, shape being determined by graphical method illustrated below. Diameter line shows only four divisions, but eight are used in laying out prop.

NAME OF ENGINE	H.P.	R.P.M.	PROP. DIA.	PROP. PITCH
FORD MODEL A	40	1800	72"	42"
HEATH HENDERSON	27	3000	54"	42"
LAWRENCE 28	28	1750	60"	46"
INDIAN CHIEF	22	2500	51"	40"
HARLEY DAVIDSON 74	20	2000	51"	40"
INDIAN SCOUT	18	2000	48"	36"

Fig. 2. Propeller pitch, diameter may be determined from this table.

It is generally believed that propeller making is a difficult process requiring a complicated machine and skilled operator. This is not the case, however. An amateur can make a very efficient propeller by doing his work carefully and accurately.

The success of the propeller depends on his accuracy. It is advisable that the airplane propeller design be purchased, as it is engineered down to a fine point too technical for explanation here. The design and complete working drawing in the form of a blueprint may be purchased at a very reasonable price. The following design information, however, will prove very practical on propellers to be used on ice sleds, boats, hydrogliders, etc.

The first consideration in designing a propeller is the number of rpm's it should turn to enable the engine to develop its maximum hp. The number of rpm's is governed principally by the pitch and diameter of the propeller. This information for various engines may be obtained from the table. (Fig. 2).

Some engines turn clockwise and some counter-clockwise, therefore the propeller must be made accordingly.

After the pitch and diameter have been determined, the shape will next enter into the problem. Two conventional propeller shapes are shown in Fig. 1. The club propeller, with an aspect ratio of approximately 6, will produce more thrust on engines turning less than 2000 rpm. All engines turning over 2000 rpm should be equipped with a toothpick propeller with an aspect ratio of approximately 8.

Don't Gear Down Propellers

Some believe that the above speeds are too great for a propeller to maintain efficiency, therefore they try to reduce the speed by gearing the propeller down slower than the motor. This is a mistake. The tip speed of a 4 ft. propeller turning 2000 rpm is the same as the tip speed of an 8 ft. propeller turning 1000 rpm.

Also, the efficiency gained, if any, would not be enough to offset the power lost due to the friction of the gears.

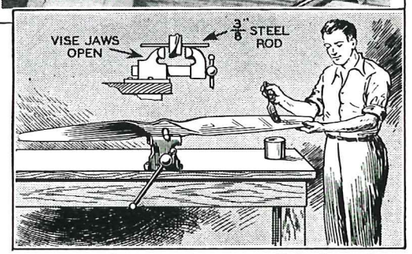
The diagram showing the graphical method of determining propeller pitch is practically self-explanatory. (Fig. 2). The vertical and horizontal lines are drawn to scale to represent the pitch and propeller diameter respectively. The horizontal line is divided into four equal parts.

By drawing straight lines from the top of the vertical line through these division points, the correct pitch at intervals along the blade will be found.

Upon finishing the working drawing you are ready to begin the construction of the propeller. Since spruce is the strongest known wood for its



Heavy cutting is done with a drawknife as demonstrated here. First both blades are shaped down roughly, and then smoothed off with spokeshave as illustrated top right photo.



Balancing the prop is accomplished as demonstrated above. Note that steel rod supports blades in between vise jaws. If one is little overweight, balance with little varnish or dope.

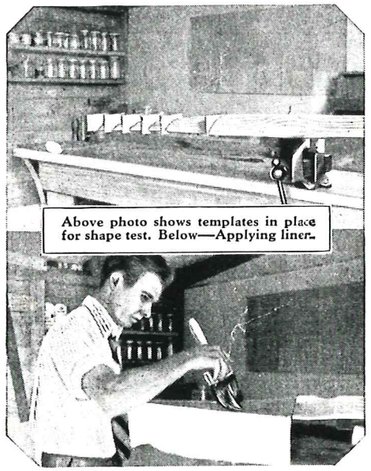
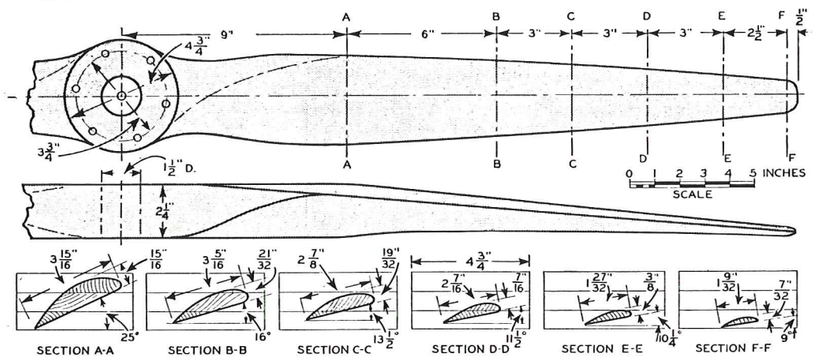


Fig. 3. Here is sample set of templates for toothpick propeller. They are made from light gauge aluminum, and to exact likeness of prop blade profiles in working drawing. Photo at top shows how templates are applied to blade in shape test.



weight and is also easily worked, this would be the logical choice of woods.

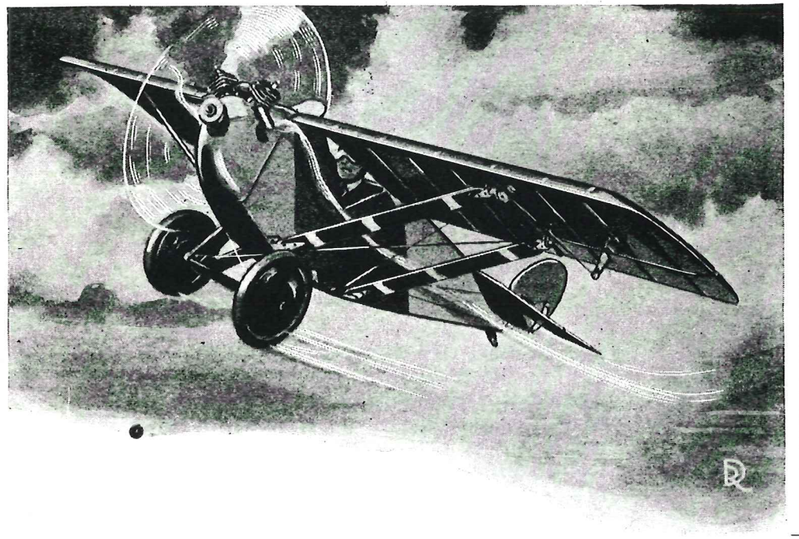
Birch, Black Walnut Best Woods

On the other hand, should you desire something more elaborate, the two kinds of wood most widely used for this purpose are birch and black walnut.

The propeller is made up of layers of wood ¾ in. thick. These layers are laminated (glued) together under a pressure of not less than 150 lbs. to the square inch. The glue should be allowed to set at least 12 hours.

The outline of the propeller is then traced on the laminated board, which is sawed out with a band saw, or if that is not available, a jig saw will serve the purpose. This wooden form is called a propeller blank, and is ready to be carved.

Before beginning the actual carving, make a set of light gauge sheet aluminum templates. These are made to an exact likeness of the propeller blade



Readers of this 1933 Flying Manual may glance at the plane (left) and remember the good old days, when a lightplane when built, might fly and then again, it might not. Designed in 1922 the plane (left) known as the HD-12 is given credit by Andy as starting the wave of enthusiasm for lightplanes in this country. With unusually hot engines this design was occasionally flown. Contrast her with the crop of planes produced in the flying year 1932, ten years later, as shown on the opposite page.

ANDY INTRODUCES THE 1933 FLYING MANUAL

You among my friends who have read my monthly blast of opinion, gossip and information which has run in Modern Mechanix and Inventions *may be interested in hopping up on the wing of the good ship Progress and taking a look with me at the lightplane situation as it has developed during the last 10 years in this grand old kentry of ourn.*

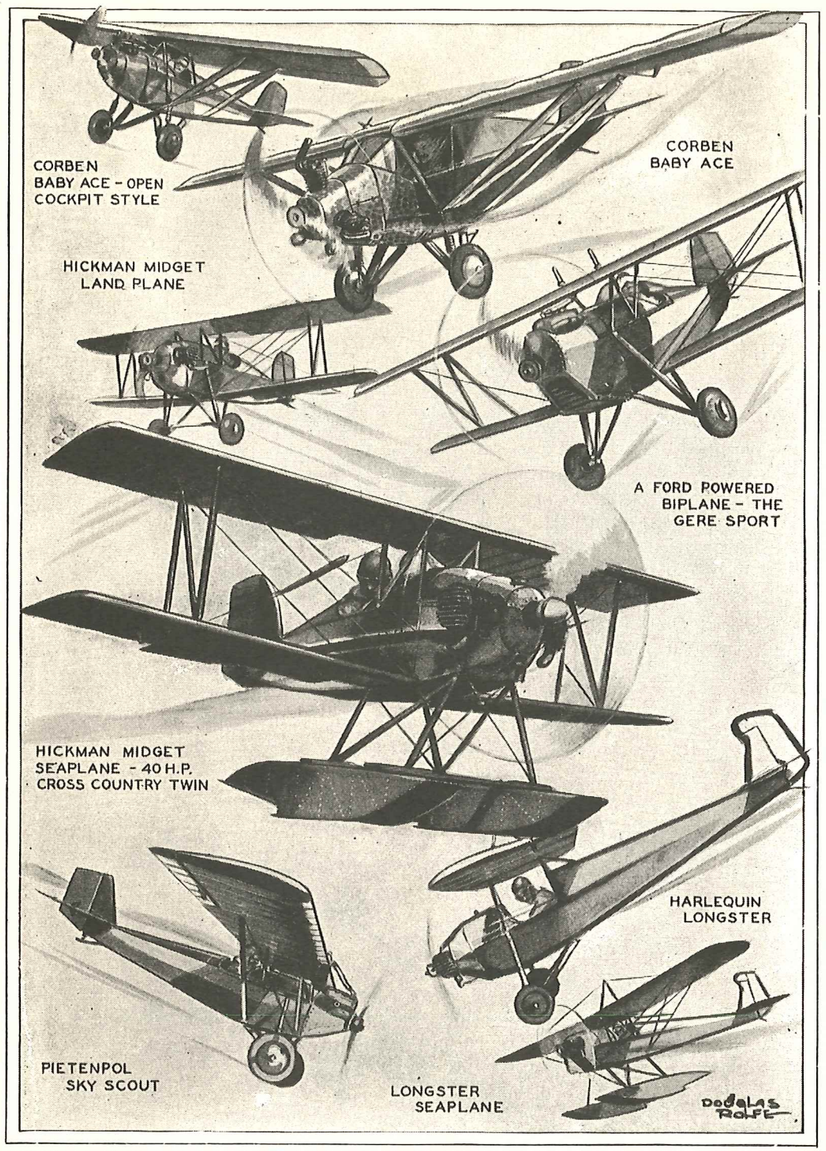
The survey is amazing.

Ten years ago, in 1922, to be exact, we heard rumbles and a lot of excitement from Lympne in England where the post-war pilots were doing amazing things with low-powered ships.

Lympne is a section of England where terrain and weather conditions were ripe for the foregathering of all souls who were interested in flying light stuff. Many war designers and pilots, who learned to love the air as something practical during the scrimmage days, still clung to the idea that flying could be popularized. They bent their efforts toward showing the world that it might expect a flivver of the air, and that the flyer and the flying machine were properly part of a nascent industry — not merely circus attractions.

These birds did a swell job. They flew with light little bugs powered with everything from 3 hp motorcycle motors to smaller ships with two seats and about 32 hp.

In light of history about all it proved was that almost anything will fly, no matter what it looks like, if it is light enough and has sufficient power to get off the ground. Practically and at the same time the net effect was to get a lot of diminutive figures into print which stirred the imagination of everybody. The boy at the crossroads who was to become



This year's crop of lightplanes is the most versatile the Flying Manual has yet offered. The ships tend toward more weight and higher power, but there still are a few real midgets among 'em, notably the little Hickman Seaplane which is our cover subject this year. The Henderson Longster is another light fellow. Take your pick!

INTRODUCTION . . . This, the 1933 Flying and Glider Manual, probably more than any of the other issues, instilled in the citizen of the thirties the desire to build and fly aircraft. The designs presented here were intriguing and were within the reach of the average man's pocket book. It is interesting to note that after over thirty years this historical material is much sought after and that the same man—Douglas Rolfe, who did the many drawings, sketches and covers, has been available to prepare all the covers for this series.

The EAA Aviation Foundation salutes all of these pioneer airmen, designers and builders who were the stepping stone, the inspiration for today's sport aviation and the many educational benefits received. Come visit our EAA Air Adventure Museum.

PAUL H. POBEREZNY, Chairman
EAA Aviation Foundation

profiles in your working drawing. When finished the templates should look like the profiles shown in Fig. 3.

In order to hold the propeller secure without damaging it while carving, a hardwood block about 1 in. by 2 in. by 4 in. is bolted to the hub with a ⅜ in. bolt. This block, with propeller attached, is then held securely in a vise. Begin carving by roughly cutting down the flat side of the blades first.

A draw knife or similar instrument is used for this purpose. Both blades being carved roughly, they are then smoothed down with a spokeshave and tested with the templates. The high places are then scraped and sandpapered. This process is continued until the templates fit snugly in place.

If the propeller is made of spruce, at least three-fourths of each blade must be covered with linen or grade "A" airplane fabric, doped on. This is not necessary for the hardwood propeller, although it is desirable that it be tipped to prevent splitting.

Upon completion the spruce propeller is given four coats of dope. The hardwood propeller is sanded smooth with No. 00 sandpaper and then varnished.

Balancing the propeller is next. This should be done in a place where the air is perfectly still. A vise will serve as a balance stand. The top of the jaws must be smooth and level. A short length of ⅜ in. steel rod is passed through the ⅜ in. hole in the propeller hub.

The propeller is placed horizontally in the vise and is supported by the rod, each end of which rests on the jaw of the vise. If the propeller does not balance, the light end should be coated with varnish or dope, depending on the finish, until it does balance evenly.

In order to insure perfect tracking, it is necessary that the hub be bored on a drill press. This being done, the propeller is mounted on the motor and tested for track in the following manner: Turn the propeller until it is vertical. Next place a box on the floor so that the lower tip just touches it, then turn the propeller one-half revolution.

If the other tip just touches the box, the propeller tracks perfectly. If the propeller does not track perfectly, it can be made to do so by shimming one side of the hub with sheet aluminum. •••

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1933

FLYING MANUAL

EAA Aviation FOUNDATION



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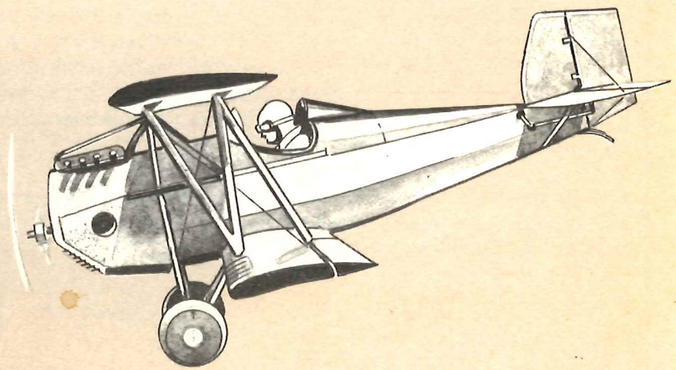
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BUILD and FLY



THE SPORTPLANE AUTHORITY OF AMERICA